

embedded fixtures and into the corners of the forms. The Contractor shall protect the anchor bolt threads against damage.

7. Backfill. Forms may be removed twenty-four hours after concrete is placed. All forms shall be removed before backfilling. Excavated material shall be used as backfill. Backfill shall be placed in layers and tamped to prevent future settlement of backfill materials. The excavated material not needed and backfilled shall be disposed of by the Contractor.

Foundations for embedded type strain poles shall have concrete placed with the pole braced in the required attitude (rake) until the concrete has set. Bracing may be removed after several days.

8. Other Structures. Foundations for poles and pedestals mounted on bridge structures and walls shall be included in the structure and/or wall item. Coordinate the installation of anchor bolts with the structure construction. U-type anchor bolts may be used in lieu of standard anchor bolts.

1319.02 Ground Mount Cabinet Base Breakaway Extension. This work shall consist of furnishing and installing a breakaway extension for the specified controller or cabinet foundation which includes cinder brick walls, galvanized extension anchor bolts with coupling and finishing the walls with sand-cement grout in accordance with the details.

1319.03 Staking. The Contractor shall provide staking, unless otherwise indicated, where no locations or staking are dimensioned. Staking shall be in accordance with Item 623 with the exception that staking shall be incidental to the payment of each item for which the stake is provided.

1319.04 Method of Measurement. Foundation concrete shall be the number of m³ (cubic yards) as determined by calculations from plan dimensions, in place, complete and accepted, and shall include excavation, reinforcing steel, conduits, concrete, backfilling, and disposal of surplus excavation.

Breakaway extension for ground mount cabinet bases shall be measured as a unit in place and shall include all extension bolt hardware, cinder brick grouting and finishing.

1319.05 Basis of Payment. Payment will be made at the contract price bid per m³ (cubic yard) or per unit price bid for the concrete foundation as specified and a per unit price bid for a breakaway extension for ground mount cabinet foundations. This shall be full compensation for all labor, materials, tools, equipment and incidentals necessary for each item furnished complete in place and accepted.

Item	Unit	Description
1319	m ³ (Cubic yard)	Concrete for or each anchor base foundations.
1319	m ³ (Cubic yard)	Concrete for or each embedded pole foundations.
1319	Each	Ground mount cabinet foundation breakaway extension.

ITEM 1320 - GROUNDING EQUIPMENT

1320.01 Equipment Grounding

- 1320.02 **Ground Rods**
- 1320.03 **Structure Grounding**
- 1320.04 **Method of Measurement**
- 1320.05 **Testing of Ground Rods**
- 1320.06 **Basis of Payment**

1320.01 Equipment Grounding. All equipment ground wiring and hardware shall be in accordance with the plans and details. All non-current carrying metal parts, poles, pedestals, cabinets, conduit and equipment shall be grounded. Payment for providing and installing the grounding material shall be incidental to the item grounded, except where an equipment ground wire is installed with the ungrounded wiring for circuits. In such cases a pay item will be specified.

1320.02 Ground Rods. Ground rods and associated cables shall be in conformance with 625.10. The ground rod shall be copper clad (bonded copper to steel) high strength steel, 25mm diameter by 3m (1" x 10'). The ground cable shall be minimum No. 4 AWG insulated with 600 Volt Class, Type RHH/RHW/USE or UF insulation. The wire shall be exothermically welded to the top of the ground rod and connected to the pole, pedestal, or enclosure ground.

The ground rod shall be driven the entire length, with at least 300mm (1 foot) of cover, in undisturbed earth and at least 300mm (1 foot) from the foundation, unless otherwise specified.

1320.03 Structure Grounding. The Contractor shall furnish and install a complete grounding system where specified in the plans and in accordance with Item 625.20 and the details.

Ground rods used shall conform to Item 1320.02.

1320.04 Method of Measurement. Ground rods shall be measured as the actual number of 3m (10 foot) lengths used and shall include the cable welded to the ground rod(s) and connections. Structural grounding shall be measured as a unit including all ground rods, cable and connections as shown on the plans and details.

1320.05 Testing of Ground Rods. Each ground rod must be resistance-tested and documented as per Item 625.22.

1320.06 Basis of Payment. Payment will be made at the contract unit price bid for each item installed complete, connected, tested and accepted and shall be full compensation for all labor, materials, tools, equipment and incidentals.

Item	Unit	Description
1320	Each	Ground rod
1320	Each	Structural grounding

ITEM 1321 - CONDUIT, RISERS AND TRENCHING

1321.01	Trench, by Depth
1321.02	Trench, Paved Areas, by Type
1321.03	Drain Trench
1321.04	Conduit
1321.05	Conduit, Jacked Under Pavement
1321.06	Weatherhead and Conduit Risers
1321.07	Conduit Markers
1321.08	Method of Measurement
1321.09	Basis of Payment

1321.01 Trench, by Depth. The Contractor shall provide trenching where specified in accordance with Item 625.12 and of the depth herein specified.

1321.02 Trench, Paved Areas, by Type. In addition to the provisions of Item 625.12, the Contractor shall trench paved areas as shown on the details. Premarked sawcut lines shall follow existing joints or grooves where possible and shall be approved by the Engineer before sawing. Restoration shall be in accordance with Item 603.09 with backfilling, surface restoration to previous condition and disposal of surplus material.

1321.03 Drain Trench. The Contractor shall excavate to a width and depth sufficient to allow proper connection of drain conduit to proposed sewer connection.

Backfilling shall meet the applicable requirements of Item 603 and Item 625.

1321.04 Conduit. Conduit shall be of the type and size as specified on the plans. The materials furnished and used in this work shall be installed in accordance with the details and the requirements of Section 625.13. All conduit installed shall be pitched to drain toward the pullboxes which have drain connections to a storm sewer, and shall include all elbows, fitting and connections. The pull cable shall be 10mm (3/8") minimum braided nylon or polypropylene twist rope rated for 10,000N (2500 pounds) breaking load and 1,000N (250 pounds) working load. Pull cable shall be installed in all conduit which will not have circuit wiring or cabling installed during construction.

Rigid metal conduit shall be galvanized steel or heavy-wall threaded aluminum and shall be in accordance with Item 713.04.

PVC conduit shall meet the requirements of Item 713.07 except that the types shall be described as follows:

Type I (Type DB or Sch. 40) - use with Class C concrete encasement.

Type EB is not accepted.

Type II (heavy wall) - schedule 40 min. use for direct burial or on wood poles as specified.

Drain conduit to sewer lines shall be cast iron pipe, including elbows and fittings, and shall meet the requirements of ASTM A-74.

1321.05 Conduit, Jacked Under Pavement. The work of this item shall include furnishing and installing rigid metal conduit meeting the requirements of Item 1321.04, including drilling under paved areas.

Conduit to be placed under existing pavement or paved shoulder shall be furnished and installation accomplished by jacking or horizontal drilling in accordance with the details, and with the approval of the Engineer. When the drilling method is used, the bore shall not exceed the conduit outside diameter by more than 5 percent. Conduit shall be installed with the least amount of disturbance to existing facilities with all operations maintained within the right-of-way. Push pits or other necessary excavations shall be backfilled and surfaces restored in accordance with Item 603.09.

1321.06 Weatherhead and Conduit Riser. The weatherhead and conduit riser shall provide a wiring raceway for signal, power and/or lighting cable from a traffic control cabinet, safety switch, lighting controller, pedestrian signal, push button or others as specified to the overhead span wire, termination point for service connection and/or an underground pullbox or foundation.

The weatherhead shall be Schedule 40 PVC. Conduit shall be steel or heavy-wall threaded aluminum per Item 1321.04 and PVC Type II per Item 1321.04.

Galvanized steel or aluminum shall be used from the ground line up to 2.5m (8') height on the pole. All conduit above 200mm (8") shall be Type II PVC.

A 10mm (3/8 inch) drain (weep holes) shall be drilled at all low elevation points in the conduits at elbows as shown in the details. Conduit clamps shall be galvanized steel or malleable iron for wood poles and stainless steel banding 1mm x 20mm (1/32 x 3/4 inch) for steel poles. Clamps or bands shall be spaced 1.5m (5 feet) on centers from 2.5m (8 feet) and above grade and 750mm (2-1/2) feet on all conduit below 2.5m (8 feet) above grade.

Grounding bushings shall be provided to ground steel conduit where wood poles are specified and shall be OZ No. 2004, M & W GB-550 or approved equal. PVC conduit may be installed directly into the top of a street lighting controller and safety switch, in which case grounding bushings may not be required. Connections into the top of any enclosure shall be with approved watertight fittings.

1321.07 Conduit Markers. The Contractor shall provide a conduit marker of non-corrosive material as shown on the details and where conduit is specified and installed dead ended beneath grade. Payment shall be incidental to the item of conduit installed.

Where specified or as directed by the Engineer, the Contractor shall furnish and install precast or cast-in-place concrete markers as indicated on the details and constructed in accordance with the applicable requirements of Item 511.

1321.08 Method of Measurement. Trenching shall be measured as the number of meters (feet) of trench measured from center to center of foundations, pullboxes, etc., and shall include all excavation, backfill, compaction, disposal of surplus material and restoration of disturbed facilities and surfaces.

Conduit shall be measured as the number of meters (feet) of conduit furnished and installed measured from center to center of pullboxes, foundations, etc., and shall include all fittings, appurtenances, joints, bends, grounds and concrete encasement where specified. Where jacking is specified, conduit and jacking shall be one pay item.

Weatherhead and conduit riser shall be measured as a complete unit, in place, by conduit diameter including all fittings, clamps, banding, bushings and weep holes.

Conduit markers shall be measured as a complete unit precast and/or cast in place.

1321.09 Basis of Payment. Payment will be made at the contract unit price bid for each of the items as specified, furnished complete and in place, and shall include all labor, material, tools, equipment and incidentals necessary.

Item	Unit	Description
1321	Meter (foot)	Trench, ____ mm (inches) deep.
1321	Meter (foot)	Trench, paved areas, less/more than 150mm (6")
1321	Meter (foot)	Drain trench
1321	Meter (foot)	Conduit, ____ mm (inches) (diameter)____ (specify type) ____ (specify concrete encasement or jacked under pavement where required).
1321	Each	Weatherhead and conduit riser, ____ mm (inch) (diameter)
1321	Each	Conduit marker

ITEM 1322 - ELECTRICAL BOXES

1322.01 Concrete Pullboxes

1322.03 Junction Boxes

1322.04 Sectionalizers

1322.05 Method of Measurement

1322.06 Basis of Payment

1322.01 Concrete Pullboxes. The construction of pullboxes shall be by size and type specified and as shown in the details. Excavation shall be performed as nearly as practicable to the outside dimensions of the pullboxes. After pullboxes are set to proper grades, excavated spaces around pullboxes shall be backfilled with suitable material placed and thoroughly tamped in thin layers.

The pullboxes shall be cast-in-place using Class C concrete with the frame cast integral with the pullbox. End bells and couplings for conduit entrances shall be cast with the pullbox or a section of each of the walls may be blocked out

prior to the casting, in which case the end bells and couplings shall be grouted into place. Reinforcing steel shall be provided in all pullboxes installed in streets and driveways. Where drainage is specified, the pullbox shall be provided with a concrete floor, a 75mm (3-inch) drain conduit, as specified in the plans, and a cats iron strainer. The Contractor shall provide 12mm (1/2-inch) preformed joint sealer conforming to Section 705.11 between all pullboxes and abutting paved areas. All openings and spaces shall be grouted and finished to the satisfaction of the Engineer.

Frames and covers shall be cast iron meeting the requirements of ASTM Specification A-48 Class 30 for regular duty pullboxes and ductile iron meeting the requirements of ASTM Specification A-536 Grade 60-40-18 for street duty pullboxes. Frames and covers shall be of uniform quality, free from blow holes, porosity, hard spots, shrinkage defects, cracks, warps, or other injurious defects.

The Contractor may furnish precast pullboxes as an alternate. All precast pullboxes furnished shall be constructed of reinforced Class C concrete and meeting as a minimum all dimensions and requirements for cast-in-place pullboxes. The width of the walls shall be sufficient to recess the frame into the casting. Spaces between the casting and frame shall be grouted to secure the frame to the casting.

1322.03 Junction Boxes. Junction boxes shall be fabricated of cast iron or steel and hot dipped galvanized in accordance with ASTM A123. Boxes shall be raintight, UL approved and installed as shown on the details. The work of this item shall include all approved mounting hardware. All hardware shall be of a non-corrosive material.

Where junction boxes are embedded in concrete structures, the boxes shall be provided with drains.

1322.04 Sectionalizers. Sectionalizers shall consist of terminal strips and cabinet for mounting on poles in the vicinity of the interconnecting cable line. Installation and mounting hardware shall be as shown on the details.

Sectionalizer terminal strips shall be the barrier type rated for a minimum of 600 volts insulation. Terminal poles shall be rated for a minimum of 30 amps and shall be the tubular screw type with pressure plate sized from 1 to 3 No. 12 AWG wires. The number of poles per terminal strip shall be twelve (12) and the number of strips shall be as indicated in the details for the type required.

The terminal strip frame shall be bakelite, nylon or approved high quality insulating material.

As an alternate, the sectionalizer terminal strips may consist of poles provided with sliding or movable links for opening and closing circuits without disturbing any connected wiring. The links shall be designed to prevent accidental contact with adjacent poles when opened. All nuts, bolts, links, lugs and washers shall be silicon bronze metal, nickel-plated, stainless steel or approved equal. All insulating posts or barriers and terminal frame shall be bakelite, nylon or approved high quality insulating material rated for 600 volts (min). The bolts for each pole shall be cast with the terminal frame molding to provide the most rigid pole.

Terminal strips shall be mounted in the cabinet on stand-offs as shown in the details.

The cabinets shall be weather proof and raintight meeting the requirements of NEMA Type 3R and shall be equipped with approved wing type, butterfly link lock or luggage type stainless steel latches.

All wiring connection at the sectionalizer shall conform to the requirements of Item 1323.05.

1322.05 Method of Measurement. Pullboxes shall be measured as a complete unit, in place, and shall include excavation, forms, concrete class C, frame and cover, reinforcing steel, grouting, conduit fittings, strainer/cesspool, aggregate, 12mm (1/2 inch) expansion joint, backfilling and restoration of the immediate area.

Junction boxes shall be measured as a complete unit, in place, including all mounting hardware, anchors and drains.

Sectionalizers shall be measured as a complete unit, in place, including cabinet, terminal strips, lugs, connections, mounting hardware, reversible clamps and testing.

1322.06 Basis of Payment. Payment will be made at the contract unit price bid or each item furnished and installed complete and accepted including all labor, materials, tools, equipment, and incidentals.

Item	Unit	Description
1322	Each	Pullbox, concrete, __, mm (inches) x __ mm (inches), type
1322	Each	Junction box, __ mm (inches) x __ mm (inches) x __ mm (inches)
1322	Each	Sectionalizers, __ type

ITEM 1323 - CABLES, CONNECTORS AND ACCESSORIES

1323.01 Cable, By Type and Size

1323.02 Messenger Wire

1323.03 Connector Kits

1323.04 Splice Kits

1323.05 Connections

1323.06 Method of Measurement

1323.07 Basis of Payment

1323.01 Cable, By Type and Size. Cable and wire shall be of the type and size specified and routed in accordance with the plans and installed according to the details. Cable and wire shall be furnished with the specified number and size of conductors, the required insulation voltage rating and cable service type specification.

All cable and wire jackets shall be indelibly marked every 1.5m (5 feet) showing the manufacturer's name, wire size, voltage rating, and type and style.

All cable and wire shall be rated at 600 volts except TCCS Cable with conductors of solid copper unless otherwise specified. Cable by type shall meet the following requirements:

Service Cable shall be serial self-supporting cable with an aluminum clad steel support wire as electrical neutral (duplex or triplex) or two conductor or 2 each one-conductor power cable supported with a 6mm (1/4 inch) messenger cable per Item 1323.02. Duplex or triplex cable shall be neoprene or cross-linked, polyethylene insulated conductor(s) (1 for duplex, 2 for triplex), cabled around a bare seven strand ACSR neutral messenger of the same AWG size as the insulated conductor(s) except that the ACSR messenger shall be no smaller than No. 4 AWG.

Service Cable (duplex or triplex as specified) shall be installed aerially from a remote power source to the structure or pole housing a controller cabinet, street lighting controller or disconnect switch.

Power Cable shall be two single stranded copper conductors or a two conductor cable and shall be installed from the local source to the disconnect or controller enclosure. Cable type shall be RHH/RHW/USE insulated and installed with sufficient excess cable to allow Cincinnati Gas and Electric Company crews to connect to their secondary or service point.

Where traffic signal controllers are specified, power cable shall be routed in a separate 25mm (1 inch) conduit from the controller cabinet to the service connection.

Feeder and Pole and Bracket Cable shall be RHH/RHW/USE insulated. Equipment ground conductors shall be of a green color insulation or permanently marked or identified with green markings in accordance with the National Electric Code.

Series Street Lighting Cable shall be No. 8 AWG, solid copper, single conductor, rated 5000 volts, 60 hertz, A. C., rubber insulated, neoprene jacketed for direct burial service. Insulation thickness shall be min. 4mm (10/64 inch) and the neoprene jacket thickness shall be min. 1.5mm (4/64 inch).

Traffic Signal Cable shall meet the requirements of IMSA Specification 19-1 or 20-1 with Solid Copper conductors.

Signal cable shall be installed between signal heads and controller cabinets, and interconnect cable installed between controller cabinets of different intersections, as shown on the plans. Signal and interconnect cable shall be suitable for aerial installation supported by messenger wire or for routing within underground conduit. When so specified, interconnect cable shall be of the serial self-supporting integral messenger type with a figure "8" cross section and shall include pole clamps. Electrically shielded interconnect cable shall be furnished when specified for either the standard or aerial self-supporting type used on installations where multiplexing is performed or where transient electrical impulses could be detrimental. Shield type interconnect cable shall meet the requirements of IMSA 19-2 or 20-2.

Electric Cable for electrical signs and island lighting shall be two (2) conductor, type RHH/RHW/USE or UF insulation. Cable furnished with insulation meeting IMSA 19-1 or 20-1 may be accepted.

TCCS Cable - Traffic Control Communication System Cable shall be twisted pair, shielded communications cable #19 AWG, unless otherwise specified. Cable shall meet the Rural Electrification Administration (REA) specification PE-39, type BJFC and shall be flooded (filled) with a petrolatum - polyethylene translucent gel compound applied in a Liquid State. Cable shall be applicable for direct burial service, installations in underground conduit and aerial routing when supported by a separate messenger cable.

Conductors shall be solid, soft drawn, annealed bare copper. Insulation shall be solid, virgin high density polyethylene or polypropylene, with standard telephone industry color coding. Cable core shall be insulated conductors twisted in pairs. Shielding shall be 0.13mm (0.005 inch) solid copper tape shield with overlap to provide 100% electrical shielding coverage. Outer jacket shall be black, low density, high molecular weight virgin polyethylene and shall withstand sunlight and temperature variations.

Number of pairs shall be specified.

Loop Detector Wire shall normally be No. 14 AWG, THWN, Stranded of a continuous length from the spliced connection to the pair of shielded conductors in the lead-in cable splice or controller terminal when the loop wire is connected directly to the controller terminals. The loop wire shall be protected by a flexible vinyl plastic tubing of 5mm (3/16 inch) I.D., a minimum of 1mm (1/32 inch) wall, and 6.4mm (1/4 inch) O.D. The tubing shall be capable of resisting deterioration from oils and solvents. The tubing shall also be highly abrasion resistant and have a smooth bore. The wire shall be inserted into the vinyl plastic tubing for the full length from the point of splicing and placed into the slot with the number of turns as shown on the plans, or as directed by the Engineer. The tubing shall be of a continuous length from the point of splicing of the loop wire to the lead-in cable. No splices will be made in the tubing. The wire shall also be pushed carefully into the slots with a blunt tool to avoid damaging the insulation.

At the time of placing the loop wire in the sawed slots, the ends of the tubing shall be sealed within the splice to prevent any entrance of moisture into the tubing.

All lengths of loop wires and tubing that are not imbedded in the pavement shall be twisted with at least 16 turns per meter (5 turns per foot), including lengths in conduits and pullboxes.

Where specified, a conduit fitting shall be provided on a riser in lieu of a pullbox for detector wire and lead-in cable splicing. Payment for the flexible vinyl plastic tubing and conduit fitting where spliced shall be included in the cost of the Loop Detector Wire.

Loop Detector Lead-in Cable shall be used to connect the loop detector wire to the loop detector amplifier. Splice the lead in cable to the loop wire in pullboxes with approved water-tight splices meeting Item 1323.04. Splices in conduit fittings where specified (where the loop wire is not provided with a pullbox for splicing) shall require soldering the connections together in a butt splice or the using of approved crimping connectors and adequately insulating each cable in the splice individually with approved weather-proof electrical tape and then wrapping the entire splice with approved weather proof electrical tape and finishing the splice by enclosing it in approved heat shrink tubing.

The lead-in cable shall be twisted multi-pair (as required). No. 14 AWG or 18 AWG stranded, shielded, polyethylene insulated, chrome vinyl jacketed cable rated 400 volts for 18 AWG and 750 volts for 14 AWG. The shield shall be grounded only at the amplifier.

1323.02 Messenger Wire. Messenger cable shall be copper clad steel stranded cable of the size specified including lashing wire and all accessories as shown on the plans and detail.

Messenger wire shall meet the requirements of ASTM specification B228 grade 30 EHS with mechanical properties as follows:

CITY SIZE DESIGNATION	STRAND SIZE	O.D. OF WIRE APPROX.-MM (INCHES)	MINIMUM BREAKING STRENGTH- N (POUNDS)
1/4"	(3 ea.) No. 9AWG or	6.27	22,815
		(0.247)	(5,129)
	(7 ea.) No.12AWG	6.15	25,221
		(0.242)	5,670
5/16"	(7 ea.) No.10AWG	7.77 (0.306)	40,906 (9,196)
3/8"	(7 ea.) No. 8AWG	9.78 (0.385)	61,786 (12,890)

The messenger wire shall be installed so that the entire load of signal equipment will result in a sag of 3% of the span length. The Contractor shall exercise due caution when stringing and loading the messenger wire in order that the strain poles, either momentarily or for any period of time, are not loaded to permanent set (load at yield stress).

The lashing wire shall be No. 14 AWG bare solid copper wire and applied to tightly wrap all signal cable to the messenger wire at the rate of six and one-half turns per meter (two turns per foot). The lashing wire shall be terminated to the messenger with approved split-bolt connectors. Copper preformed lashing rods may be used in lieu of the No. 14 wire with approval of the City Traffic Engineer.

Bull ring aerial corners, crossover clamps, 3 bolt messenger clamps (guy grips), thimble eye through bolts, messenger hangers shall be drop forged steel and hot dipped galvanized in accordance with ASTM specification A-153 and shall have a designed holding strength without slipping or breaking of at least 45,000N (10,000 pounds).

Messenger wire shall be fastened at the poles with thimble eye through bolts (wood poles) or with two wraps around the pole (steel poles) and shall be secured with a 3 bolt messenger clamp with the wire end served into a 130 to 180 mm (5 to 7 inch) maue.

1323.03 Connector Kits. Connector kits shall meet the requirements of Item 713.15 for the type specified and installed in accordance with the plans and details.

Fusible Type kits shall be furnished with UL Class CC - 600 Volt fuses, 10 amp unless otherwise specified.

1323.04 Splice Kits. Where splicing is required in accordance with the details or specifically specified or as directed by the Engineer, the Contractor shall provide all labor and materials. Kits shall be in compliance with ANSI C119.1 for "permanent water resistant cable splicing kit" and shall also meet the requirements of Item 713.15. Splices for series circuits shall be rated for 5000 volts.

Multi-conductor (3 or more conductors) cable shall be spliced in accordance with the details in Standard Drawing ES-3-9.

No splices shall be permitted in saw cuts or conduit. The Contractor shall be responsible for correctly measuring the cable to prevent unnecessary or unapproved splices. Splices may be made in pullboxes, cabinets and as shown in the details.

All splices shall be approved by the City and shall be incidental to the item of cable to be spliced.

1323.05 Connections. Connections with a live master or TCCS cable or shall be made by City of Cincinnati forces.

Connections with a de-energized master or TCCS cable shall be made by the Contractor. All connections shall be approved by the City of Cincinnati and the circuit tested by the Contractor before final connection to the energized master line.

When a series lighting circuit must be disconnected to splice cables, notify the Cincinnati Gas and Electric Company to provide the cut out and cut in service.

All connections and disconnects with the Cincinnati Gas and Electric Company's systems shall be made by Cincinnati Gas and Electric Company personnel.

1323.06 Method of Measurement. Cable shall be measured in place, complete and accepted. Aerial cable shall include pole attachment hardware and splice enclosures. Lead-in cable shall include poured epoxy insulated splices. Measurement shall be: (a) horizontally from center to center of pullboxes, poles, cabinets, power sources, and electrical devices with an additional allowance of 1.5m (five feet) at each pullbox, pole, etc. for slack and connections; and (b) vertically between pole or conduit outlets. When single conductor power cable is substituted for multi-conductor cable, payment shall be based on the required length of multi-conductor cable. Power cable shall include any costs incurred to arrange the service installation by the supply agency.

Loop detector wire shall be measured from the pullbox center to the pavement edge, hence the actual feet running in the pavement loop slots depending on the number of turns laid, and returning to the pullbox, plus 1.5m (5 feet) at each end for slack and splice.

Magnetometer Probe Cable shall be included with the installation of the probes.

Messenger wire shall be measured in place, complete and accepted, and shall include all necessary accessories such as thimbles, clamps, bullrings and lashing rod. Measurement shall be from pole center to pole center, or pole center to bullring, or bullring to bullring, as required. The measurement shall not include any length of messenger wire for attachment to poles, or bullrings by bending, lapping or wrapping.

Connector Kits shall be measured in place as a complete unit, accepted, including fuses as required. Splice kits shall normally be included with the item of cable; however, where specified, splices shall be measured in place, complete and accepted as a unit item.

1323.07 Basis of Payment. Payment will be made for accepted quantities of cables, wire, connectors, and kits and shall be full compensation for all labor, materials, tools, equipment and incidentals necessary for each item furnished complete, with all connections made and wiring tested and accepted.

Item	Unit	Description	
1323	Meter (foot)	___ Cable/wire ___ conductor No. ___ AWG	
1323	Meter (foot)	___ pair of TCCS Cable	
1323	Meter (foot)	Service cable, ___ plex, No. ___ AWG	
1323	Meter (foot)	Messenger wire, ___ strand No. ___ AWG, (___ diameter) with accessories	
1323	Each	Connector Kit, type ___ with 10 amp fuse (where applicable)	
1323	Each	Cable Splicing Kit	

ITEM 1324 - TRAFFIC AND LIGHTING CONTROLS

- 1324.01 Photoelectric Cells
- 1324.02 Street Lighting Relays
- 1324.03 Lighting and Traffic Control Disconnect Devices
- 1324.04 Traffic Signal Controller, Installation Only
- 1324.05 Auxiliary Traffic Control Cabinets
- 1324.06 Method of Measurement
- 1324.07 Basis of Payment

1324.01 Photo-Electric Cell. Photoelectric control shall be a solid state, cadmiumsulfide type with hermetically sealed silicon rectifier. Rated surge protector shall be provided and a fail-safe operating 120 volts, 60 Hz. Built-in feature shall be included so that lighting circuits will remain energized in the event the photo control components become inoperative.

The relay contact rating shall be 500 watts minimum with an inrush capacity of 900 volt amperes and capable of operation within temperature range of minus 1°C (30°F) to 55°C (130°F). Relay contacts shall be snap acting to minimize arcing. Switch leaves on which contacts are mounted shall be independent of thermal elements.

The sensing element operating range shall be from 5 to 16 lx (0.5 to 1.5 FC) "ON" and 16 to 50 lx (1.5 to 4.5 FC) "OFF" operation foot candles. The cell shall be hermetically sealed with three locking type blades that fit a socket which meets E.E.I. Pub. No. 148 and N.E.M.A. Pub. No. 18 standards.

A time delay of a least 15 seconds to prevent switching due to lightning shall be incorporated into the switching operation. The device shall include a socket mounted on a pole top or bracket adapter with wiring terminals. Furnish the socket and all mounting hardware.

Furnish and install 3 No. 14 AWG, 600 volt, type RHW/USE cables from the photo cell to the lighting controller. Observe the following color code:

Black Wire for "line"

Red Wire for "load"

White Wire for "Neutral"

The photo-electric cell shall be mounted at least 8m (25 feet) or more up on the designated pole above any artificial light or street lighting, and shall be oriented with the sensing element facing north.

1324.02 Street Lighting Relays. Street Lighting Relays shall be provided and installed in pullboxes or cabinets as specified in accordance with the plans and details and shall be used where luminaires are served from underground vaults and where the use of street lighting controllers are precluded. Relays shall be provided for one or more luminaires as indicated but restricted to serving no more than two 1000 watt metal halide type luminaires.

The relay shall be provided in a weatherproof housing of aluminum, molded fiberglass or other approved non-corrosive material.

The relay shall be equipped with normal closed type with mercury wetted contacts rated for 30 amps (min.) and with the coil operated at 120 volts. Adams & Westlake Cat. No. 1140-50-7A, Permatrol No. 64-RE-850 South Bend Controls, Inc. No. MRR-TD-6246 or approved equal.

Included with the relay shall be an approved lighting arrestor with a 30 amp cartridge type fuse (UL Class SK-1) connected to the line side of the relay contacts.

Provide mounting brackets and approved non-corrosive hardware.

1324.03 Lighting and Traffic Control Disconnect Devices.

1. General. Street Lighting Controllers and/or safety switches shall be of the size specified and in accordance with the plans and details.

2. Enclosure. The enclosure shall be a NEMA type 4X and shall be fabricated from No. 16 gage or heavier AISI Type 302, 303, or 304 annealed stainless steel. All seams shall be fully welded and all fastenings used in the assembly or mounting of the enclosures shall conform to ASTM A-320 (AISI-300 Series).

Each enclosure shall be provided with a door so constructed that it may not be opened when the disconnecting handle is in the "on" position.

The front mounted switch handle shall not be part of the door. The door shall be single piece full length construction, hinged on the left side (facing the front of the enclosure) with latching device dogs near the top and bottom.

The door shall be provided with a mechanism interlocking the door latch and the operating handle, including provision for padlocking both in the "on" and "off" position. The mechanism shall be defeatable in the following sequence when the operating handle of the disconnecting device is in the "on" position. (1) Release door latch with one hand on door latch handle while simultaneously operating door latch defeater screw with a screwdriver in the other hand. (2) Open

door with one hand on door latch handle while simultaneously operating disconnect handle defeater screw with a screwdriver in the other hand.

The door latch defeater screw shall be sufficiently recessed within its housing so as not to be turned with a coin or flat washer.

The door latch mechanism shall provide that the door handle must be turned to fully engage its latch before the disconnect handle can be moved to the "on" position.

3. Components. The enclosure shall contain the following factory wired units mounted on a removable panel:

- A. One 2 pole or 3 pole (as indicated below) heavy duty fusible disconnect switch of rated for 600 volt class.
- A1. Three pole - for street lighting controllers.
- A1. Two pole, 3 wire, 2 fusible poles with solid neutral - for safety switches.

Fuse clips shall be adjustable and sized for up to 250 volt cartridge type fuses. Fuses shall be either the 120 or 240 volt size as per the voltage application required and shall be the UL Class RK-1, fast acting, current limiting with minimum 200,000 amps interrupting capacity; BUSS Limitron Series, E-Shawmut Amp-Trap Series or approved equal.

Switches shall be furnished with fuses as specified in Table 1324.03.

TABLE 1324.03

Enclosure Size (Amperes)	Power cable No. 6 Size	Enclosure Nominally Furnished Fuse Size (Amperes)	Power Service Conduit Riser	Neutral Bar Lug Sizes
100	3 # 1 2 # 2	80	38mm (1-1/2") 32mm (1-1/4")	2 ea.#1 to 2/0 8 ea.#4 to 1
60	3 # 4 2 # 6	45	32mm (1-1/4") 25mm (1 inch)	2 ea.#4 to 1 8 ea.#8 to 4
30	3 # 6	25	25mm (1 inch)	10 ea.#8 to 4

Where 240 volts is required use sizes specified with 3 wires. For 120V systems use sizes specified with 2 wires.

- B. One neutral bar with ten tubular screw lugs size as per Table 1324.03.
- C. One Cabinet ground lug.
- D. **For Street Lighting Controller Only.** One three pole lighting contactor.

Contactor coil 120 volts, 60 Hz. with contacts rated for tungsten and ballast lamp loads as follows:

480 volts maximum line to line voltage.

277 volts maximum line to neutral voltage.

250 volts DC.

One 3 Position Selector Switch, rated minimum 15 amps, 600 volts, for "HAND-OFF-AUTO" control. The switch shall be located inside of the enclosure.

(Furnish only if specified) A Time Delay Relay "time out with Power interruption" type 120V 60 Hz, 2 ea. SPST or 1 DPDT isolated contacts rated 10 amps Min. approx. 1 to 60 second timer Set for 20 seconds, Ambient Temp. Range -40 to +50°C. The relay shall be equipped with surge protection, and equipped with Octal Socket. Potter-Brumfield Model CDB-38-70012 or approved equal.

- E. **Enclosure Facilities.** The "line" and "load" leads shall be marked and easily accessible with provisions for connecting external wiring into the enclosure.

Two mounting flanges shall be provided on the outside of the enclosure, one on the top and one on the bottom. The flanges shall be drilled or slotted for mounting bolts or screws with no sharp corners or burrs.

The cabinet shall be large enough to admit a 75mm (3 inches) conduit hub in either top, bottom, or back near bottom to allow entrance of external circuits and not disturb normal function of internal units.

Wiring space of 50mm (2 inches) shall be provided between housing and internal units.

Each switch enclosure shall be furnished with a padlock. Padlocks shall be master No. 500 KA series or equal by Russwin, Corbin or others but shall be keyed to accept master No. 255 key change.

Mounting Hardware. Mounting hardware shall be galvanized steel lag screws (for wood pole mounting) or stainless steel banding 1.5 x 22mm (1/16 x 7/8 inch) dimension (for steel pole mounting).

The enclosure shall be mounted on poles with the top of the enclosure 3m (10 foot) above grade.

1324.04 Traffic Signal Controller, Installation Only. The work of this item shall consist of hauling and installing the signal control equipment including signal controller, detector amplifiers, control cabinet with base (for ground mounted types), all of which will be furnished by the City of Cincinnati, in accordance with the details and plans.

The installation shall be complete and ready to operate from a 120 volt, 60 Hz. electrical service.

The Contractor shall make all terminal strip connections between the controller and signal heads, pedestrian signals, signs, detectors, push buttons, and de-energized interconnecting cable. The Contractor shall install and wire all control equipment to produce the intended color sequence display and signal operation.

Where the cabinet is specified as the ground mounted type, the Contractor shall install the cabinet on the foundation provided under Item 1319.01.

Where the cabinet is specified as the pole mounted type, the Contractor shall install galvanized hanger plates on the cabinet using stainless steel nuts and bolts and maintaining the cabinet watertight. The cabinet shall be fastened to wood poles with galvanized lag screws and to steel poles with 1.5 x 22mm (1/16 x 7/8 inch) stainless banding. For steel poles, a 65mm (2-1/2 inch) galvanized steel conduit ell shall be installed from the cabinet bottom into a nipple welded in the pole for a wiring raceway. A pole mounted cabinet shall be installed with 2/3 of the cabinet height 1.5m (5 feet) above ground and shall be mounted on the side of the pole away from the street (field side).

1324.05 Auxiliary Traffic Control Cabinets.

1. General. Furnish and install traffic control cabinets by the type specified including all components and parts as required for each type of application intended or specified for the cabinet. Each unit furnished shall be complete, ready for service and installed in accordance with the plans and details.

2. Cabinet. The cabinet shall be corrosion resistant, weatherproof, NEMA type 3R, constructed of cast aluminum material with strength equivalent to 5mm (3/16 inch) thick material having a minimum yield strength of 125,000 kPa (18,000 pounds) per square inch or corrosion resistant steel sheet at least 1.5mm (0.06 inch) thick or 16 gauge AISI type 302, 303 or 304 annealed stainless steel.

The cabinet shall be free of cracks, burrs, blowholes, casting flashes and any excess material or imperfections.

A gasket groove shall be cast or constructed around the periphery of the door and/or cabinet housing and a neoprene gasket shall be inserted in the groove to provide a watertight and dust tight seal between the door and housing.

The door shall be double hinged with stainless steel hinge pins and shall have a latch bolt, steel armored, self-locking with a dust cover which shall be keyed to the City of Cincinnati standard (Corbin Key Change No. 1R 6380).

The exterior of an aluminum cabinet shall be painted in accordance with Item 1317 with an aluminum color finish coat.

Cabinets equipped with fans and all ground mounted (Type G) cabinets shall be furnished with vents at the top (where fan is furnished) and at lower sides of the cabinet. Vents shall be suitably baffled and screened for protection against moisture, dust and insects.

Cabinet doors, except door-in-door, shall be furnished with a bar stop-catch to retain door in an open position at an angle of between 120° and 135°.

Type PL and G cabinets shall be furnished with a door-in-door (police door) located in upper front center of cabinet door. The door-in-door shall be provided with gasket as specified for the main cabinet door to provide a water and dust tight seal. The door-in-door shall provide access to a recessed panel or wall but not the interior of the cabinet. The recessed panel shall be of sufficient size to house up to five (5) switches and a manual control cord.

The key for access to the door-in-door shall be Corbin No. 0357SGS, Crousehinds No. KL-3123, Eagle Signal Company No. E-7322 or approved equal having the same key change.

3. Installation. Pole mounted (Type P and PL) cabinets shall be equipped with mounting flanges or plates on the top and bottom for fastening to poles. Mounting hardware and accessories shall be furnished for fastening to wood and steel poles. Conduit entrances into the cabinet shall be field drilled and only into the bottom of the cabinet.

Pedestal mounted (Type P and PL) cabinets shall be field drilled for mounting on the specified pedestal. All nuts, bolts and washers for securing cabinet to pedestal shall be stainless steel, cadmium plated or corrosion resistant metal. A neoprene or suitably equivalent gasket shall be provided to seal the pedestal hub to the cabinet. The pedestal specified to be furnished under Item 1318.02 "pedestals" shall be provided with a flanged hub which shall be incidental to the payment of the cabinet.

Ground mounted (Type G) cabinets shall be furnished with base and anchor bolts. The foundation, anchor bolt construction, size and placement shall be as indicated for Type I (regular) as shown on the detail sheet. The Contractor shall install the cabinet on the foundation provided under Item 1319.01.

4. Components for All Types and Applications. Cabinets shall be furnished with the components as specified herein and as listed in Table 1324.06B for the traffic control application specified.

A. Lighting Arrestor shall meet the following minimum requirements:

Voltage Class: 125 volts - single pole.

60 Hz Sparkover: 1000 volts rms.

Critical Impulse Sparkover: 2400 volts

(1-1/1 x 40 MS wave).

Discharge voltage at 10,000 amps: 900 volts

(10 x 20 MS wave).

The arrestor shall be installed on the line side of the 50 AMP fuse (where furnished) otherwise on the line side of the main circuit breaker.

B. Circuit Breakers shall be high-magnetic trip type suitable for the cabinet as specified with atmospheric temperature range of from -30°C to 50°C (-20°F to 120°F). Each circuit breaker shall be of the size specified in Table 1324.06B and shall have a manual switch for on-off and reset operation.

C. Common Neutral Terminal Bus shall be solid copper or brass of the tubular screw type sized for No. 4 to No. 14 gauge wires. Number of poles required shall be as specified in Table 1324.06B.

D. Terminal Strips shall be the barrier type rated for a minimum of 600 volts insulation. Terminal poles shall be rated a minimum of 30 amps and shall be the tubular screw type with pressure plate sized for from 1 to 5 each No. 14 gauge wires. Number of poles required shall be as specified in Table 1324.06B.

E. Panel Board and/or shelf shall be constructed of minimum 6mm (1/4 inch) rigid noncombustible, high insulated (minimum 600 volts), moisture resistant material.

F. Relay Fuse shall be a panel mounted type with socket and cap. Fuses shall be glass tube type, 125 volt (unless otherwise indicated on Table 1324.06B), slow blow, dual element.

- G. Load Relays** shall be DPDT-Double break with a minimum life of two million cycles and operable within an ambient temperature range of from -55°C (-67°F) to +60°C (140°F).

The coil shall be rated for 120 volts with the pull-in voltage between 95 to 102 volts ac. rms. Contacts shall be rated a minimum 15 amps incandescent lamp load at 120 volts and 30 amps resistive load at 240 volts ac. rms. with an inrush current rating of at least 240 amps. Contacts shall be silver cadmium oxide with gold flash.

Insulation between all elements and ground shall be a minimum 1500 volts ac. rms.

Relay sockets shall be constructed with knife switch type contacts (6mm wide by 1.5mm [1/4 inch wide by 1/16 inch] thick) of cadmium-plated phosphor bronze. Insulation between all contacts and ground shall be a minimum 1200 volts ac. rms.

- H. Control Relays** shall be rated for continuous duty, double break with a minimum life of one million cycles and operable within an ambient temperature range of from -30°C to 60°C (-20°F to +140°F). The coil shall be rated for 120 volt service. Contacts shall be rated a minimum 5 amps inductive load at 120 volts ac. rms. and 10/5 amps resistive load at 120/240 volts ac. rms.

Insulation between all elements and ground shall be a minimum 500 volts.

Relays shall be plastic encased and furnished with a commercially available octal (8 pin) keyed, high dielectric phenolic socket.

All interior cabinet wiring shall be of the sizes and colors shown on the details and of THW or THWN insulation rated for 600 volts.

All interior cabinet wiring not indicated on detail sheets shall be THW or THWN and shall be sized adequately for the fuse and/or breaker rating and shall be color coded according to N.E.C.

5. Components for Reversible Lane Control Station Cabinets.

- a. Load Center** - Furnish 1-20 amp circuit breaker for the Type I station. Furnish 1-20 amp and 1-15 amp circuit breaker for the Type II Station.
- b. Selector Switch** shall be heavy duty rotary power switch, 2 sections or decks, non-shorting 5 position, break before make. The contacts shall have a minimum make and break rating of 5 amps at 115 volts A.C. resistive load. The insulated decks shall be of steatite or ceramic rated for minimum of 600 volts between contacts and ground. Indexing between contacts minimum 20° to maximum 36°. The switch shall be bushing mounted with pointer knob and installed in an aluminum enclosure for surface mounting on panel board.

6. Components for Relay Stations Only.

- a. Chassis with cover** shall be at least 300mm (11 inches) wide by 450 mm (17 inches) long by 50mm (2 inches) deep, 18 ga. zinc plated finished steel.

- b. **Relays** shall meet the requirements for Paragraph 4H control relays.
- c. **A variable resistance element** consisting of a 69 watt, 125 volt incandescent standard traffic signal lamp with porcelain cleat type receptacle.

TABLE 1324.06A
CABINET TYPES - DIMENSIONS

Dimensions													
	Height				Width				Depth				
	Min.		Max.		Min.		Max.		Min.		Max.		
Cabinet Type	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	Notes
Type P, Pole or Pedestal Mounted	21	550	24	600	14	350	17	450	12	300	14	350	Inside Dimensions
Type PL, Large Pole or Pedestal Mounted	36	900	42	1000	21	525	24	600	14	350	16	400	Outside Dimensions
Type G, Ground Mounted	*46	1200	*50	1250	28	700	32	800	15 1/2	400	20	500	*Including Base

TABLE 1324.06B
CABINET APPLICATIONS - COMPONENTS

Spec. Para Ref.	Components	Unit	Controller Installation	Sampling Detector or Counting Station	Reversible Lane Control Station	Relay station	Multi-Speed Advisory Sign Control Station	School Flasher Time Control
	Cabinet Type		PL G	P PL G	P	P	P	P
A	Lighting Arrestor	Ea.	1 1	1 1 1	1	1	1	
B	Circuit Break. No. & Current Size	No. Size	2 2 30 30	1 1 1 15 15 15	2* 1-15, 1-20	1 15	2 15	2 15
C	Neutral Bus (Min.) No. of Poles	No. Poles	12 15	10 12 15	8	5	10	1
D	Terminal Strip No. of Poles (Min.)	No. Poles	40 50	20 30 40	11	30	20	4
E	Panel Board (Dim. Width x Height)	Dim.	-- --	-- -- --	12 x 9 300mm x 230 mm	--	--	
	Shelf No. Required	No.	-- 1	1 2 3	-- --	--	1**	
F	Relay Fuse (Amp Capacity)	Amp.	-- --	-- -- --	2 Each 2A 150V	5	-- --	
G	Load Relays	No.	-- --	-- -- --	2	--	3	
H	Control Relays	No.	-- --	-- -- --	--	11	--	** * Time Clock

* NOTE 1: Furnish Load Center with main rating of 40 amps, surface mounted with cover.

** NOTE 2: Furnish where Detector Amplifier(s) also specified with this cabinet. Shelf shall be incidental to payment of cabinet.

*** NOTE 3: City will furnish time clock for school flasher time control.

7. General Information. The purpose of the relay station is to maintain an acceptable voltage level (i.e., above 105 volts) on the interconnecting cable by refreshing the line with new service at specified locations.

Where "controller installation" application is specified, payment of this item shall include procuring the specified controller equipment (dial units, panel board, relays, etc.) from the City and remounting controller equipment in the specified cabinet. This is in addition to the required components of this specification. The City shall supervise, inspect and advise Contractor as to the methods and arrangement of installing the equipment in the cabinet.

Where other items refer to this specification for cabinet construction and components, payment will be made under that specified item.

1324.06 Method of Measurement. Photo-electric cells shall be measured as a complete unit in place, including socket, mounting hardware and wiring to the disconnect device.

Street Lighting relays shall be measured as a complete unit in place, including enclosure, components and mounting hardware.

Lighting and traffic control disconnect devices shall be measured as a complete unit in place including padlock, fuses and mounting hardware.

Traffic Signal Controller shall be measured as a complete unit in place, including connections and mounting hardware.

Auxiliary traffic control cabinets shall be measured as a complete unit in place, including all components per the application specified, wiring and mounting hardware.

Auxiliary control equipment shall be measured as a unit installed, connected and tested.

1324.07 Basis of Payment. Payment will be made at the contract unit price bid per each item as specified and shall be full compensation for all labor, materials, tool, equipment and incidentals necessary for each item furnished complete, connected, tested and accepted.

Item	Unit	Description
1324	Each	Photo-electric cell
1324	Each	Street lighting relay
1324	Each	Street lighting controller, ___ amp
1324	Each	Safety switch, ___ amp
1324	Each	Traffic signal controller, ___ mount type, including control equipment, installation only
1324	Each	Reversible lane control station type ___
1324	Each	Relay station
1324	Each	Control cabinet, type ___ mounted (Installation only - option)
1324	Each	School flasher Time Control

ITEM 1325 - LUMINAIRES

1325.01 Luminaires

1325.02 Method of Measurement**1325.03 Basis of Payment****1325.01 Luminaires.**

1. General. Luminaires shall be of the type specified and shall consist of a complete lighting device, including housing, supporting hardware, reflector (as required in the specified type) refractor, socket, lamp, integral ballast (or remote ballast where specified), disconnection devices, terminal block for external wiring connections, photo-electric cell receptacle and incidentals as required. The luminaire shall be capable of operating the specified lamp in a completely sealed optical system (as required in the specified type) at the line voltage specified. The luminaire shall provide the ANSI-IES Type distribution and cut off as specified.

The light source for the luminaire shall be specified.

2. Luminaire Types

- a. **Standard Roadway Type:** shall mean a cobra head style housing designed for mounting on bracket or mast arms.
- b. **Underpass Type:** shall mean a "wallpack" type housing designed for wall mounting.
- c. **Post Top Mounted Type:** shall mean a decorative "colonial" or "modern" style luminaire for post top mounting.
- d. **Spherical Roadway Type:** shall mean a decorative, classic, spherical shaped fixture resembling an "eye ball" for use with high (12m [40'] or more) mounting heights and mounted on short slip-fitter arms.

3. Interchangeability. The refractor shall be interchangeable with the "standard" refractor of the same wattage and type luminaire. "Standard" refractors shall be refractors manufactured by the General Electric Company, Westinghouse Electric Corporation, Hollophone Company, McGraw-Edison Company, and J. H. Spaulding Company.

4. Supply Voltage. The luminaire shall operate as required herein when the primary voltage has the specified nominal value, or is within tolerances required by the specified ballast. The primary voltage shall normally be 240 volts, unless otherwise indicated, for all luminaire types except the spherical roadway type which shall be 120 or 240 volts as specified.

5. Housing. Luminaire enclosures shall conform to the construction and material specified herein for the type luminaire specified.

- a. **Standard Roadway Type.** Luminaires shall be cast aluminum with natural finish or a painted finish in light gray. The housing for the luminaire shall have a two or three piece design consisting of the upper housing and a refractor holding lower door. Where the luminaire is of a three piece design, the third piece shall be a lower access door for access to internal components independent of the refractor door and located to the rear of the refractor door toward the house side. Lower door assemblies shall hinge away from the upper half on the house end.

The lower door assemblies shall have latching mechanisms located on the street side and closeable with one hand.

The refractor holding door shall permit easy removal of the refractor without the use of tools and have a safety catch to prevent accidental removal.

An access door may be provided for access to internal components or the components may be mounted on the door.

The slipfitter shall be adjustable to fit pipe brackets from 30mm to 50mm (1-1/4 inch to 2-inch pipe) brackets. The slipfitter shall permit an adjustment in the vertical plane of plus or minus 5 degrees and the luminaire shall have a slip fitter stop which allows an engagement of at least 115mm (4-1/2 inches) of the bracket arm.

- b. **Housing for the underpass type luminaire** shall be cast aluminum with natural finish or a painted finish in Light gray and shall be provided with conduit mounting holes for wire entry and secured to a wall or vertical surface with two (2) each 10mm (3/8 inch) bolts through the rear of the fixture. The fixture shall be designed to open easily with a quick snap hinged ring or approved latching device. The refractor shall be protected by means of an approved guard or shield.
- c. **Housing for the post top mounted type luminaire shall be cast** aluminum with a slip-fitter suitable for a 75mm (3-inch) O.D. tenon. 3 sets screws or 2 bolts shall be provided to facilitate leveling and securing the fixture on the pole. The luminaire shall be hinged on one side (colonial style) and secured with a captive screw on the opposite side. Where the modern style luminaire is specified, a captive hand nut shall allow easy (no-tool) assembly and disassembly of the canopy.

The luminaires shall be painted black or pole green (per item 1317) as indicated on the plans.

- d. **Housing for the spherical roadway type luminaire** shall be fabricated of heavy gauge aluminum, polyester, or equivalent light weight high strength material. The external portion of the housing shall form a 700mm (28-inch) diameter sphere.

The housing shall be able to be easily opened for servicing the interior components. This may be accomplished by fabricating it as two hemispheres joined together or by other approved means.

The bottom of the housing shall have an opening to accommodate the light output of the optical unit.

Incorporated between the opening in the bottom of the housing and the reflector portion of the optical system there shall be a low brightness baffle designed to minimize visibility of the light source from a horizontal distance greater than five mounting heights from the luminaire.

The housing support shall have a mechanical adjustment to allow about-the-axis adjustment as well as vertical adjustment to 25 degrees.

A slip fitter device may be attached internally or externally either to the housing support or to the optical assembly, so long as the complete luminaire and all its parts are firmly supported.

Painting: All exposed parts of luminaire shall be factory painted. Aluminum parts shall be painted after anodizing.

Prime coat (submarine epoxy) - 115 μ m (4.6 wet mils) thickness.

Intermediate coat - 175 μ m (7 wet mils) thickness.

Final coat - Cincinnati MALT Pole Beige: Federal Standard Color 20372; or Foy-Johnson No. 29842 or equal by Porter, Wilson, or Pratt & Lambert - spread at rate of 7m²/L (300 sq. ft/gallon) or 135 μ m (5.3 wt mils) thickness.

- e. **All type housings complete with components** shall be weatherproof, and all components including ballast shall be mounted internally unless otherwise specified. The refractor, reflector and ballast system shall be easily removable. The luminaire complete shall be constructed to withstand winds to 160 km (100 miles) per hour.

6. Reflector. The reflector shall be readily detachable and removable and in spherical roadway type luminaires supported from its top, the reflector shall consist either of pressed prismatic heat resisting glass with sealed and spun-on cover, or a spun aluminum diffused material with aluminum-coated (Alzak) finish. The inner surface of the reflector shall be smooth, non-porous and easily cleaned.

Reflectors shall be required in all type luminaires except the post top mounted type.

7. Refractor. The refractor shall be heat and high impact resistant material of polycarbonate or a heat resistant borosilicate glass or approved equal and shall be so designed that it can be installed only in the correct position in the refractor holder. Glass shall be well annealed and free from imperfections and striations.

The refractor shall be embossed to clearly indicate the street side and house side prisms.

Panels used with the colonial style post top mounted luminaire shall be white frosted.

For spherical roadway type luminaires the bottom of the reflector shall be covered with a gasketed door containing a large refractor.

Type A Refractor: Clear non-prismatic crystal glass for resisting breakage due to heat and mechanical stresses well annealed and free from imperfections and striations. When in place and with the luminaire operating, the window shall withstand a heavy sprinkling of ice water.

Type B Refractor: Convex refractor with prisms meeting the requirements previously specified for refractor material of polycarbonate or glass.

8. Optical seal. This shall consist of compressible, heat resisting nonlatex, resilient gasketing material to seal out insects, dust, dirt and water effectively. There shall be a complete sealing of the optical system at the point of entry of the socket into the reflector and between the reflector and the refractor. The gasket shall be readily removable from the reflector.

Post top mounted type luminaires shall not require an optical seal.

Standard roadway type luminaires shall be provided with a carbon filter to eliminate accumulation of dirt and other foreign matter in the optical system.

9. Ballast. Each luminaire shall be furnished with a single-lamp ballast. the ballast shall be internally mounted unless otherwise specified. The ballast shall be of a high power factor of at least 90 percent. The ballast shall be capable of starting lamps in temperatures as low as -30°C (-20 degrees F), and shall be rated for the circuit voltage and size of lamp specified.

A nameplate identifying the electrical and mechanical characteristics of the ballast shall be a permanent part of the ballast.

The ballast provided shall have the wattage rating of the lamp specified and the weight of the internal ballast shall not exceed 14kg (30 pounds). Allowable ballast losses listed in Table 1326.02 shall be considered average losses.

Where specified, external ballasts furnished shall be epoxy encapsulated, suitable for aerial, post top, pole base or vault installation and shall be enclosed in a corrosion free weathertight aluminum tank. A minimum of 300mm (12 inch) long leads shall be provided for external connection and the lead wiring insulation shall be rated for such service.

In addition to the foregoing general characteristics, ballasts shall conform to the following characteristics for the type specified.

BALLASTS FOR MERCURY VAPOR LAMPS shall be the constant wattage or regulator type with separate primary and secondary windings and shall deliver rated lamp current at circuit voltage variations of plus or minus 13 percent.

The regulation output of lamp wattage shall not exceed a total range of 4 percent for lamps rated 400 watts or less or 6 percent for lamps rated in excess of 400 watts.

BALLASTS FOR METAL HALIDE LAMPS shall be the peak load auto regulator type and shall deliver rated lamp watts within plus or minus 10 percent with plus or minus 10 percent variations in applied voltage.

BALLASTS FOR HIGH-PRESSURE SODIUM LAMPS shall be the regulator type with isolated primary and secondary windings for up through 400 watts. For 1000 watt lamps, ballasts shall be the auto regulator type. In both cases the ballast shall delivery rated lamp current at circuit voltage variations of plus or minus 10 percent.

Ballasts shall be complete with started components. The starter component shall be comprised of solid state devices capable of withstanding ambient temperatures of 100 C. The starter shall provide timed pulsing with sufficient follow through current to completely ionize and start all lamps that meet published ANSI standards. Starters shall be field replaceable and completely interchangeable with no adjustment necessary for proper operation and have push on type electrical terminations to provide good electrical and mechanical integrity and ease of replacement.

The starter circuit board shall be treated in an approved manner to provide a water and contaminant resistant coating. The starter circuit-ballast combination shall be designed to consistently provide the following parameters:

- a) Lamp wattage must be maintained within the trapezoid recommended by lamp manufacturers within the full rated input voltage range.
- b) Amplitude of the pulse 2500 volts minimum and 4000 volts maximum. Operation of the pulse at spike voltage levels near minimum is desirable.

- c) Minimum pulse width 1 microsecond at 2250 volts, and shall be applied within 20 electrical degrees of the peak of the open circuit voltage wave, and have a minimum repetition rate of one pulse per cycle of the 60 cycle wave.
- d) Pulses must be present when ballast is correctly wired and nominal voltage less 15 percent is applied to the ballast windings.
- e) The high pressure sodium ballast, including starting aids, shall protect itself against normal lamp failure modes. The ballast shall be capable of operation with the lamp in an open or short circuit condition for six months without significant loss of ballast life. The luminaire manufacturer shall supply ballast electrical data and lamp operating volt-watt traces for nominal and plus or minus ten percent rated line voltage to verify ballast performance and compliance with ANSI lamp specifications, for the rated life of the lamp.

10. Socket. The socket shall be of a rugged high grade porcelain body with a mogul screw shell type base and rated for 600 volts (5000 volt impulse for high pressure sodium lamps). The socket shell shall be of nickel or nickel plated and shall have lamp grips to prevent the lamp from loosening. When the lamp is in its normal operating position, all metal on the lamp base shall be covered by the porcelain of the socket body.

The socket shall be adjustable in standard roadway type luminaires to provide other ANSI-IES type distributions. A means of identification to associate each lamp position which each distribution shall be provided. Socket adjustment shall provide positive positionings by means of index holes, lugs or notches. Slots with infinite settings will not be acceptable. In underpass type luminaires, the socket position shall be adjustable to give a 60 or 70 degree beam angle.

11. Lamp. A lamp shall be furnished with each luminaire and shall be of the type source and wattage specified. Lamps furnished shall be in accordance with Item 1326.

Lamps for the spherical roadway type luminaire shall be 1000 watt Metal Halide.

12. Fastening, Wiring and Disconnecting Devices. All required hardware shall be of approved non-corrosive material.

Slotted head type fastening devices shall be used in standard roadway type luminaires.

Disconnecting devices where furnished shall be approved and shall be designed to prevent electrical hazard to personnel servicing the fixture.

The end of each conductor not connected to the socket shall be connected to a terminal block by spade terminals or other suitable removable connectors.

The terminal block shall provide enough terminals for incoming service wires, ground wire for safety, socket connections, and ballast connections for both internal and remote ballast location. The terminal block shall be easily accessible.

13. Wiring Diagram. A schematic wiring diagram shall be supplied with and attached to the interior of the luminaire in a permanent manner.

14. Photometric Data. The luminaire reflector and refractor shall give an IES distribution for the type luminaire specified unless otherwise specified.

- a. Standard roadway type..Medium-Semi cutoff and Type II or Type III as specified.
- b. Underpass type.....designed to direct all useful light below the normal viewing angle resulting in high utilization of lumen output.
- c. Post top mounted type...Type V (unless otherwise specified)
- d. Spherical roadway type....(Type A refractor)
(Type B refractor)

Spherical roadway type luminaire photometrics.

With Type A (Clear) Refractor - Beam Spread =

122° vertical by 122° horizontal
Max candle power = 31,751

With Type B (Prism) Refractor-Beam Spread =

134° vertical by 167° horizontal
Max. candle power = 17,121

15. Photo-Electric Receptacle. All standard roadway and post top mounted type luminaires shall be provided with a receptacle with shorting cap for City-wide interchangeability purposes. the receptacle shall meet EEI-NEMA standards and shall be a twist-lock type.

The receptacle shall be wired for 120 volts and shall be provided with an easy adjustment for orienting to the north. Weather sealing, moisture and dust proofing must be maintained.

16. Weight and Area. Luminaires complete and ready for service shall comply to the following weight and projected area requirements:

TABLE 1325

Luminaire Type	Size by Wattage	Maximum Projected Area m ² (sq. ft.)	Maximum Weight kg (Lbs.)
a. Std. Roadway Type	100-175	.15 (1.6)	16 (35)
	200-400	.15 (1.6)	25 (55)
	700-1000	.25 (2.5)	27 (60)
b. Underpass type Not applicable	—	—	—
c. Post top mounted type (both colonial and modern type)	70-175	.20 (2.0)	16 (35)
	200-400	.35 (3.8)	25 (55)
d. Spherical Roadway type	up to 1000	.40 (4.4)	23 (50)

17. Installation. Luminaires mounted on poles shall be adjusted vertically and horizontally to provide the required mounting height and specified alignment with the roadway. Where the profile grade exceeds 4 percent, the luminaires shall be oriented so that the vertical axis of the luminaire shall be perpendicular to the longitudinal centerline of the roadway at that location.

Luminaires mounted on walls shall be mounted level. Where more than one luminaire is mounted on the same wall they shall be mounted at the same elevation so as to present a straight line appearance.

Luminaires mounted on post tops shall be mounted level and in line with the vertical axis of the post.

1325.02 Method of Measurement. Luminaires shall be measured as a complete unit in place, including lamp and all components and testing.

1325.03 Basis of Payment. Payment will be made at the contract unit price bid for each luminaire, by type, and shall be full compensation for all labor, materials, tools, equipment, and incidentals necessary to furnish and install each luminaire complete, connected, tested and accepted.

Item	Unit	Description
1325	Each	Luminaire, ___ watt, ___ +volt, ___ (light - source), ___ type.

ITEM 1326 - LAMPS

1326.01 Traffic Signal Lamps

1326.02 Lamps for Street Lighting Luminaires

1326.01 Traffic Signal Lamps. A lamp shall be included in each traffic signal optical section and shall conform to the ITE specification "A Standard for Traffic Signal Lamps" with the following exceptions and qualifications: (a) brass screw bases with a rotational adjustment feature shall be required; (b) lamps shall be installed and the base rotated so the open portion of the lamp filament shall be in an upward position; (c) lamps shall have a minimum rated life of 8000 hours with the exception of 135 and 150-watt lamps which shall have a minimum rated life of 6000 hours; (d) 60-, 90- and 135-watt lamps shall be Krypton gas filled.

The Contractor shall provide lamps for the respective signal equipment in accordance with Table 1326.01 (on following page).

Cost of furnishing and installing lamps shall be included in the bid price of each signal item.

**TABLE 1326.01
TRAFFIC SIGNAL LAMPS**

	Watts	Rated Volts	Light Center	Industrial Lamp Number	Rated Life in Hours
Vehicular Traffic Signal Head					
8 Inch Sections	60	120/125	62mm (2 7/16")	60AT19 or 60A19TS Clear	8000
12 Inch Arrow Indications	90	120/125	75mm (3")	90AT19 or 90A19/1/TS Clear	800
12 Inch Sections	135	120/125	75mm (3")	135AT19 or 135A19TS Clear	6000
Pedestrian Signal Head					
12 Inch 2 Section Type A2	90	120/125	3"	90AT19 or 90A19/1/TS Clear	8000
18 Inch 3 Line Type D2	60	120/125	62mm (2 7/16")	60AT19 or 60A19TS Clear	8000
Optically Programmed Traffic Signal Head 12 Inch Sections	150	115		M-123/131 Sealed Beam	6000

COST OF FURNISHING AND INSTALLING LAMPS SHALL BE INCLUDED IN THE BID PRICE OF EACH SIGNAL ITEM

1326.02 Lamps for Street Lighting Luminares. A lamp shall be furnished with each luminaire and shall conform to ANSI Specifications C-78 for all H.I.D. (Hi Intensity Discharge) type lamps. All lamps shall be first line, high quality having heat resistance clear glass envelopes, except that all mercury vapor lamps shall be the deluxe white type.

Where incandescent type lamps are specified, they shall meet the requirements of Federal Specification number W-L-101.

H.I.D. lamps by size shall conform to the following characteristics of the Table 1326.02.

High pressure sodium lamps shall have a ceramic arc tube interior. Lumen output at end of economic life (67 percent of rated life) shall not be less than 80 percent of initial lumen rating. Rated Life for high pressure sodium lamps is at 10 hours start. All high pressure sodium lamps shall be 100 Volt Lamps. Initial Lumens shown are for horizontal burning.

All performance data in Table 1326.02 are based on normal operating conditions.

Metal Halide lamps shall have a quartz arc tube interior. Lumen output at the end of economic life shall not be less than 65 percent of the initial lumen rating.

The rated life for metal halide lamps is at 10 hours start.

Lamp Warm-Up Time to 80% Light:

Mercury Vapor 5-7 minutes.

High Pressure Sodium 3-4 minutes.

Metal Halide 3-5 minutes.

Lamp Re-Strike Time:

Mercury Vapor 3-6 minutes.

High Pressure Sodium 1 minute.

Metal Halide 10-15 minutes.

**TABLE 1326.02
HIGH INTENSITY DISCHARGE LAMPS AND BALLAST LOSSES**

Lamps				Ballasts
Lamps (Watts)	Industrial Lamp No. by ANSI Code and Spec. No.	Rated Horizontal Initial Lumens	Rated Life (Hours)	Loss (Watts)
Mercury Vapor				
100	H38JA-100/DX-C78.1300	4,000	24,000	27
175	H39KC-175/DX-C78.1308	8,150	24,000	35
250	H37KC-250/DX-C78.1301	11,150	24,000	42
400	H33GL-400/DX-C78.1305	21,500	24,000	60
High Pressure Sodium				
70	S62	5,800	20,000	35
100	S54	9,500	20,000	44
150	S55 (55 Volt)	16,000	24,000	54
150	S56 (100 Volt)	16,000	24,000	54
200	S66	22,000	24,000	54
250	S50	27,000	24,000	65
310	S67	37,000	24,000	70
400	S51	50,000	24,000	85
1,000	S52	140,000	24,000	90
Metal Halide				
70	M98	5,000	5,000	16
100	M90	8,500	10,000	20
175	M57	14,000	7,500	35
250	M58	19,500	7,500	44
400	M59	32,000	15,000	62
1,000	M47	100,000	10,000	90

ITEM 1327 - TRAFFIC SIGNALS

- 1327.01 Vehicular Traffic Signal Heads**
- 1327.02 Optically Programmed Signal Heads**
- 1327.03 Lane Use Control Signal Heads**
- 1327.04 Pedestrian Signal Heads**
- 1327.05 School Flasher, Installation Only**
- 1327.06 Covering of Traffic Signals**
- 1327.07 Method of Measurement**
- 1327.08 Basis of Payment**

1327.01 Vehicular Traffic Signal Heads.

1. General. The signal heads shall be in accordance with ANSI No. D 10.1 or the latest revised ITE Standard for "Adjustable Face Vehicle Traffic Control Signal Heads"; whichever is more recent with any exceptions indicated herein. The signal heads shall be furnished in the arrangements shown on the plans and details.

2. Design. Traffic signals shall consist of assemblies or combinations of 8 inch and 250mm² (12 inch) units rigidly fastened together in various combinations, as specified. Assembly shall be in accordance with the Manual of Uniform Traffic Control Devices, and containing one or more sections in such a manner as to prevent entrance of dirt or moisture and the possibility of rotation or misalignment. Signals shall be constructed in such a way as to allow individual sections to be assembled or disassembled with the aid of standard tools.

Traffic signals shall be capable of both vertical and horizontal mounting. Each signal section, electrical unit and optical unit shall be interchangeable with other signal head assemblies of the same manufacturer.

3. Housing. The signal head, including the door and visor shall be constructed of polycarbonate material or as otherwise specified. The Contractor shall furnish signal heads of the material specified. If no material is specified, the Contractor may furnish the signal heads in any of the approved above materials. All parts including hardware shall be of non-corrosive materials.

8" Signal head size shall normally be 10" sq. 250mm x 250mm(10" x 10") signal head size shall normally be 350mm² (14" sq.) Signal heads exceeding these dimensions by more than 1/2" shall not be acceptable.

Polycarbonate Construction. The housing of each signal section shall be one-piece virgin ultra-violet stabilized polycarbonate resin of the specified color, injection molded having a minimum thickness of 2.5mm (0.100 inches). All sections must be equipped with metal inserts into the housing to prevent stripping of threads where required to remove fastening device such as the door, on a regular maintenance basis. No electrical wiring or terminal block shall be connected to the housing by use of self-taping screws in such a manner as to allow connections to loosen if heat

resistance is generated on terminal. The material shall be such that it will withstand 95Nm (70 ft. pounds) of impact without fracture or permanent deformation.

Alternate Construction (Aluminum). Where specified, the housing of each signal section shall be one piece dense cast aluminum.

Housing General. The area around the upper and lower openings shall be ribbed or reinforced so as to be capable of handling breaking strengths specified in the ITE Standards (Section 3.01-6).

Each housing shall contain serrated round bossed openings at the top and bottom so that it may be rotated about a vertical line and shall be capable of being securely fastened at increments of no more than 7 degrees.

4. Door. The door shall be attached to the housing with stainless hinge pins and shall be designed in a manner not to allow the door to become accidentally detached when mounted in either vertical or horizontal position. The door locking device shall be designed so as not to require tools to open and close.

5. Visor. Visors shall be of the tunnel (combination hood) type with a longitudinal rectangular bottom cut-out. It shall be tilted approximately 8 degrees and shall be equipped with four lugs, each equipped with a hole and it shall be held in place by stainless steel or brass machine screws. The lugs shall be located to permit rotating the visor 90 and 180 degrees relative to the door. The visor shall be securely fastened to the door by use of the lugs, yet shall be removable with simple tools.

Visor length shall be:

175mm to 200mm (7 to 8 inches) for 200mm (8 inch) signal heads

250mm to 300mm (10 to 12 inches) for 300mm (12 inch) signal heads

6. Optical Unit. Each signal section shall be equipped with a neoprene or other approved resilient gasket adequately sealing the lens to the door to assure a dust and moisture tight optical system. Units in the optical system shall be installed in a manner permitting easy replacements.

Reflector - Shall be of the Alzak process, or approved equal, highly polished specular finished aluminum type. It shall be easily replaceable without replacing the reflector holder. The reflector holder shall be easily replaced and should be hinged to the signal housing to allow easy access for lamp replacement.

Lamps - Shall be furnished with each signal section. The size and characteristics shall be as indicated in Table 1326.01.

Lamp Receptacle - The lamp receptacle shall be of heat resisting material and designed to properly position a medium screw base traffic signal lamp. The receptacle shall be provided with an antivibration device and a positive locking device so that the socket will not turn when the lamp is installed. Provision shall be made on the receptacle and/or the reflector to permit rotation of the lamps so that lead in wires of the lamp are up, and to secure the lamp in this position. The lamp receptacle shall be of fixed prefocus type designed for a lamp light center length of 62mm (2-7/16 inches) for 200mm (8 inch) signals and 75mm (3 inches) for 300mm (12 inch) signals.

Lens - All lenses shall be of the circular Convex type in 175mm (8") and/or 300mm (12"). If arrow lens are specified, 300mm (12") size only shall be provided. Each 300mm (12") signal section shall be equipped with the wide angle type lens. Lenses shall be fabricated of durable polycarbonate impact-resistant plastic, or approved equal. Where glass lenses are specified, they shall be in accordance with the ITE Specification. A neoprene gasket shall be provided between the reflector and the lens to assure a dust and weatherproof seal between these components when the door frame is closed and latched to the housing. Lens shall be fastened to the door by use of machine screws and lugs and shall be removable with simple tools.

All lenses must conform with ITE and ANSI standards.

7. Terminal Block. The signal head assembly shall be equipped with a barrier type terminal block. The terminal block shall have 5 poles for 3 or 4 section signal heads and 7 poles for 5 section signal heads. Wiring from the lamp sockets and external cable connections shall be terminated at the terminal block.

The terminal block shall be easily accessible and shall be removable and mounted to the interior of the signal assembly with approved nuts, bolt and washers. Sheet metal screws shall not be accepted.

8. Wiring. Wiring of the signal head assembly shall be color coded of No. 18 stranded copper fixture wire rated at 150 degrees C, 300 volts, types PF, SF, or equal per Article 310-2(a) and 402 of N.E.C.

9. Color. The signal head assembly including drop pipe and entrance fitting shall be painted in accordance with Item 1317, except that polycarbonate housings shall have the color impregnated in the resin material. Each signal head shall have one coat of a zinc chromatic primer and at least one coat of baked on gloss enamel with the colors per Item 1317.

10. Weight. Signal head weight per section shall not exceed the following:

		Maximum Weight kg (Pounds)
8 inch sections	Polycarbonate type	2 (4)
	Aluminum type	4.5 (10)
12 inch sections	Polycarbonate type	3.5 (8)
	Aluminum type	9 (20)

11. Mounting. Mounting hardware for signal heads shall be included in the item furnished and shall be as indicated in Table 1327 for the signal mounting indicated on the plans. The hardware shall conform to the requirements in the details.

In accordance with the plans, signal heads shall be mounted alone forming a one-way head, or combined with additional heads to form two-way, three-way, or a maximum of four-way heads. Multi-way heads shall be furnished with appropriate top and bottom brackets with an opening in the center of the top bracket provided for mounting purposes. Signal face height inequalities for multi-way heads shall be corrected for proper accommodation between top and bottom brackets by the use of pipe spacers.

The Contractor shall observe the clearance requirements of a minimum 5.2m (17) feet from the bottom of a signal assembly to the street grade.

TABLE 1327
SIGN AND SIGNAL MOUNTING HARDWARE

MOUNTING TYPE S=Span Wire M=Mast Arm B=Bracket Arm P=Pedestal Top	SIGN AND SIGNAL EQUIPMENT			
	Traffic Signal Head	Pedestrian Signal Head	Internally Illuminated Signs	Lane Use Control Signal Head
Mounting Hardware	Mounting Type			
6 inch, Drop-forged, Hot Dipped Galvanized Suspension Clamp	S		S	S
Adjustable Clevis	SM			SM
Combination Balance Adjuster and Weatherhead	SM		SM	SM
Mast Arm Hanger or Clamp	M		M	M
Pole Clamps	B	B	B	
Post Top Reduce and Coupling		P	P	
1 1/2 Inch Galvanized Steel for Mast Arms, Span Wire Assemblies and Pedestal Top Mountings. 1 1/2 Inch Aluminum for Bracket Arms or Polycarbonate for Bracket Arms of 15 Inches or shorter.**	SMB	BP*	SMB	SM
1 1/2 Inch Lock Nuts, Washers and all-other Incidentals necessary to make the Assembly Complete, Dust and Watertight	SMB	BP	SMBP	SM
Required Clearance from Bottom of Equipment to Grade	5.2m' (17")	Minimum 2.3m (7 1/2')	5.2m (17')	5.2m (17')

* Required where two pedestrian signals are mounted on top of the same pedestal.

**All Pipe and fittings - Schedule 40.

12. Aiming of Signals. The light distribution of the traffic signal reflector and lens will give the greatest intensity straight in front and slightly down from the signal face.

Signals shall be aimed as follows:

VERTICAL AIMING. For level approaches, all traffic signals shall be mounted so as to hang plumb. Where the approach has an angle, signal housing shall be tilted one quarter inch per 6mm/m (1/4 in./24 inches) of elevation above grade for each one percent of approach grade.

HORIZONTAL AIMING. Unless otherwise indicated on the traffic signal plan, horizontal aiming of the traffic signal heads shall be based on the following:

1. Two Signal Heads on Approach.
 - a. Left signal head shall be aimed horizontally with the beam of maximum intensity directed at a point 1.5m (5 feet) to the right of the center line of the approach roadway, at a distance of 60m (200 feet) from the stop line.
 - b. Right signal head shall be aimed horizontally with beam of maximum intensity directed at a point 1.5m (5 feet) to the left of the right hand edge of the approach roadway, at a distance of 60m (200 feet) from the stop line.
2. Two Through Traffic Signal Heads and One Left Turn Signal Head.
 - a. Left turn signal shall be aimed horizontally with beam of maximum intensity directed at the center of the left turn storage lane, if present, at a distance of 60m (200 feet) from the stop line. If the storage lane is in excess of 60m (200 feet) long, or otherwise on the center line at a distance of 60m (200 feet) from the stop line.
 - b. Left signal head for through movement shall be aimed horizontally with the beam of maximum intensity directed at the center of the farthest left lane available for through traffic at a distance of 60m (200 feet) from the stop line.
 - c. Right signal head shall be aimed as indicated in 1b above.
3. Auxiliary signal heads for special advance visibility conditions and/or signal heads facing curved approaches shall have the horizontal aiming point indicated on the traffic signal plan or as directed by the City Traffic Engineer.

1327.02 Optically Programmed Signal Heads. Optically programmed signal heads shall be furnished in the arrangements shown on the plans. Each signal section shall incorporate an optical system projecting an indication which shall be programmed to be visible only within boundaries of a specific area shown on the plans. The optical system shall be capable of being veiled anywhere to within 15° of the optical axis using procedures and opaquing material in accordance with the manufacturer's instructions.

Signal sections shall conform to applicable portions of the ITE standard and the foregoing specifications for conventional optics traffic signal heads. Optical sections shall be of the 8 and 12 inch lens size and shall be mounted alone or in combination with additional sections to optically programmed or conventional optics types to form signal faces and heads in the arrangements shown.

The components of the optical system shall comprise:

1. Lamp

2. Lamp Collar
3. Optical Limiter-Diffuser
4. Objective Lens

The lamp shall be three prong, sealed beam having an integral reflector with stippled cover and an average rated life of at least 6,000 hours. The lamp shall be coupled to the diffusing element with a collar including a specular inner surface. The diffusing element may be discrete or integral with the convex surface of the optical limiter. The optical limiter shall provide an accessible imaging surface at focus on the optical axis for objects 275m to 350m (900 to 1200 feet) distance, and permit an effective veiling mask to be variously applied as determined by the desired visibility zone. The optical limiter shall be provided with positive indexing means and composed of heat resistant glass. The objective lens shall be a high resolution planar incremental lens hermetically sealed within a flat laminant of weather resistant acrylic or approved equal. The lens shall be symmetrical in outline and may be rotated to any 90 degree orientation about the optical axis without displacing the primary image. The optical system shall accommodate projection of diverse, selected indicia to separate portions of the roadway such that only one indication will be simultaneously apparent to any viewer. The projected indication shall conform to ITE transmittance and chromaticity standards.

The housing design of optically programmed sections shall include a plus or minus 10° tilt adjustment from the horizontal while maintaining a fixed mounting axis. Optically programmed signal heads shall be rigidly mounted to prevent visibility boundary movement due to high winds or truck movement. Signals mounted on span wire shall be tied to a tether cable by a breakaway clamp installed in the lower section mounting opening.

An incandescent lamp shall be included in each optical section and shall be of the type indicated in Table 1326.01.

The housing construction shall be die cast aluminum parts and shall conform to ITE alloy and tensile requirements and have a chromate preparatory treatment. The exterior of the signal case, lamp housing and mounting flanges shall be finished with a high quality baked enamel prime and finish paint. The lens holder and interior of the case shall be optical black. Signal case and lens holder shall be predrilled for backplates and visors. Hinge and latch pins shall be stainless steel. All access openings shall be sealed with weather resistant rubber gaskets. Sheet metal parts including visors and backplates shall conform to ITE material requirements, and include a chromate preparatory treatment and optical black on all surfaces.

Mounting hardware shall be included in the Item furnished and shall be as indicated in Table 1327 for the signal mounting indicated on the plans. The hardware shall conform to the requirements in the details. Tether cable shall be 3mm (1/8 inch) braided stainless steel cable.

1327.03 Lane Use Control Signal Heads.

1. General. The unit shall consist of a single housing containing optical parts, lamps and accessories for displaying by artificial illumination either a "Red X" or a "Green (Down) Arrow" indication as specified or both where the reversible indication type is specified. The indications shall be on an opaque background.

Testing shall conform to the applicable provisions of Item 1313 - Testing.

2. Dimensions (Face Size)

Size mm (inches)	Type	Dimensions (inches)								Stroke of Indication (inches)			
		Width				Height							
		Min.		Max.		Min.		Max.		Min.		Max.	
		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
300 (12)	Single Indication	12	300	14	350	12	300	14	350	1½	40	3	75
450 (18)	Reversible Indication	18	450	20	500	18	450	20	500	1	25	2	50
600 (24)	Reversible Indications	22	550	24	600	22	550	24	600	1	25	2	50

3. **Colors and Dimensions.** Colors and indication dimensions shall comply as fully as possible with the latest ITE Standard for "Adjustable Face Vehicle Traffic Control Signal Heads". Dimensions for the "X" shall be minimum 350mm (15 inch) long cross bars.

4. **Optical Performance.** The color of lane use control signal indications shall be clearly visible for 400m (1/4 mile) at all times under normal atmospheric conditions, unless otherwise physically obstructed. The visibility angle of the lane use control signal shall be at least as great as that specified for the standard circular traffic signal head. The signal shall be designed to minimize the effect of sun phantom (i.e., reflection of incident (outside) light rays) to provide the maximum blankout effect of any indication that is not illuminated.

5. **Single Indication Type.** Lane use control signals of the single indication type shall meet the latest ITE (Institute of Traffic Engineers) Standards for "Adjustable Face Pedestrian Signal Heads" with the following supplements:

Reflectors shall be highly polished specular finished aluminum.

Lens shall be of prismatic glass diffusing type with fired on legends with opaque masking on back of lens to maximize blankout effect.

Indication shall be specified.

Lamps shall be the clear type and installed with the open portion of the filament in the upward position.

Lamps shall meet the following requirements for size of signal head.

	Min Hrs. Life	Watts	Rated Volts	Light Center	Industrial Lamp No.
12 inch signal	8000	121	125	75mm (3 in.)	121 A/TS
18 inch signal	1000	200	130	150mm (6 in.)	200 PS 30/34

6. Reversible Indication Type. Lane use control signals of the reversible indication type shall contain both the "RED X" and the "GREEN (down) ARROW" indications on the same face. The indications shall be formed by a series of lamps arranged in a matrix configuration or approved fiber optic system with no less than two (2) lamps per indication (four (4) lamps for a reversible indication type).

Each indication shall be wired separately to a terminal strip to permit display of the following indications simultaneously:

a) **Single Face Unit**

- 1) Green arrow
or 2) Red X

b) **Double Face Unit**

	FACE No. 1	FACE No. 2
1) Green Arrow		Red X
or 2) Red X		Green Arrow
or 3) Red X		Red X

The signal shall be designed to provide complete control of the indications from a control station and shall contain no components which in any way could cause "Green Arrow" indications simultaneously in both faces of a double face unit.

Where units with lamps arranged in a matrix configuration are furnished, the lamps may be designed to operate at a lower than rated voltage; however, in any case shall provide a minimum of 10,000 hours average life and produce the required light output.

Alternate light sources may be acceptable provided they meet the minimum average life and all other requirements as herein specified and are available from at least two (2) commercial lamp manufacturers.

Lamp sockets for incandescent lamp type indicators shall provide a dust and watertight enclosure for the lamps and may be of the type installed internally or recessed into the face panel complete with jeweled colored lens or an extended enclosed aluminum housing. The sockets and/or housings externally mounted shall be secured to the panel with lock nuts or rivets.

Transformers or other devices and components required in the design shall be derated 50% from capacity rating for ambient temperatures from -30°C to 75°C (-20 to +165°F). The face panel shall be hinged at the bottom or at one side. An approved louvered screen shall be provided in the case where the lamps supplied have their sockets recessed into the panel.

Fiber Optically Controlled Indications. There shall be attached to the top of the signal head a 40mm (1-1/2 inch) pipe size flanged pip hub for mounting and cable entrance.

The unit shall display alternate legends, consisting of either a red X, or a green down arrow within the same signal housing. The messages shall be bright in color against a flat black background. The displays consist of a single row of lensed fiber optic bundles. No moving parts shall be permitted to change the display. When not energized, the signal shall be blanked out (unreadable) with no phantom images, regardless of solar intensity or direction. Wide angle units shall have a viewing angle of 68 degrees centered about the optical axis. The unit shall be capable of continuous operation over a temperature range of -35F to +165F (-37C to +74C).

The module unit shall be complete with optical fiber bundles, lamps, filters, and matrix message panel and constructed in an extruded aluminum signal housing. The message display shall be black anodized aluminum, 3mm (0.125 inches) thick. All anodized finishes shall pass a 50% nitric acid solution test per The Anodized Seal Specification ASTM B 136-77. Fiberglass is not acceptable and shall not be used. The fiber optic unit shall be completely self contained and removable from the door frame. The fiber optics inside the unit shall have a protective backcover made of ABS plastic or aluminum to prevent fiber damage during installation or relamping of the signal. All serviceable sign components shall be easily accessible through the sign face door and repairs shall be made without the removal of other components. A standard screwdriver shall be the only tool necessary for routing maintenance.

One transformer with a class A insulation shall operate each lamp. It shall be impregnated with a double coating of epoxy resin or lacquer so as to preclude intrusion of moisture. The nominal primary input voltage shall be 110 volts AC with a secondary output of 10.8 volts AC under a load. The lamp, type ENL, shall be a multi-mirror reflector quartz halogen bulb consuming 42 watts of power at the supplied 10.8 volts. It shall have an average rated life of 10,000 hours of operation. The lamps shall be mounted in such a way so as to prevent their reflectors from collecting water from condensation or gasket leaks. A colored glass filter shall be mounted in front of each light source and shall be color fast. It shall be in accordance with the ITE Signal Color Specification for Chromaticity (MIL-25050A).

The optics shall be a glass on glass fiber with an 83% core to 17% cladding ratio. Each fiber shall have a 0.05mm \pm 0.005mm (0.002 \pm 0.0002 inches) diameter with an included acceptance angle of 68 degrees. All fiber ends are bundled together and shall be ground smooth and polished to an 200 μ m (8 micron) finish, minimum. Bundled fiber strands shall be kept free from the contamination of water and polishing agents. Glass fiber breakage shall be limited to 3% of the total bundle area. All fiber bundles shall be bifurcated (50/50 split of the total number of fibers in the bundle). All fiber bundles shall have an evenly randomized distribution of the fibers across the bundle so that contiguous fibers lead to alternate lamps (uniform arrangement forming a salt and pepper mixture). In the event of a single lamp failure, all output bundles shall continue to display an entire message at half intensity. A small fiber bundle located at the bottom of the display shall indicate a lamp failure. Any damaged output bundles shall be replaceable using one of the two spare output bundles from each lamp pair. Fiber optic bundles shall not be jacketed or encased which has been determined to cause long term condensation effects from thermal cycling. The output fiber bundles shall have a nominal spacing of 40mm (1 1/2 inches) between centers. On the lensed unit, a stainless steel snap ring shall mechanically hold a biconvex lens over each fiber optic bundle within a black lens holder. The lens shall be 16mm (5/8 inch) diameter. The lens holders shall be hexagonal in shape. All fiber optic

output bundles shall be mechanically threaded to the face. No epoxies or glues shall be necessary to hold the output bundle or lens assembly in place.

7. Housing. The housing shall be made of sheet aluminum, a corrosion-resistant aluminum, aluminum-alloy die casting of sufficient strength of virgin ultraviolet stabilized polycarbonate resin. All metallic joints shall be continuously welded to prevent the entrance of moisture.

All screws, nuts, bolts and fastening devices used in the signal housing shall be stainless steel. All components shall be mounted in the housing/s in such a way that they are easily accessible without de-energizing or disassembling the signal.

8. Visor. The visor shall be 18 gage (1.2mm [.05"]) min. aluminum or polycarbonate, as indicated in paragraph 7, securely attached to the housing. The visor attached to the door shall not interfere with the opening of the door.

The visor shall be constructed so that the indication is shielded from direct sunlight when the sun is 45 degrees or more above the horizon.

9. Wiring. Wiring of signal heads assembly shall be minimum 150°C, 600 volt, No. 18 AWG stranded copper fixture wire per articles 310-2 (a), 402 and 410 of the N.E.C.

A terminal strip rated at 600 volts with each pole rated at 15 amps shall be provided for wiring connection to external control cable.

10. Painting. Aluminum signal heads when specified shall be painted in accordance with Item 1317 and the following:

Paint Requirements:

1st coat (All surfaces) - Epon Oxide Baking Primer, Federal Spec. TT-P-636.

2nd coat (All Surfaces) - Medium Gray Alkyd Urea Exterior Baking Enamel, Federal Spec. TT - E-480B.

3rd coat (Yellow surface) - Federal Yellow Alkyd Urea Exterior Baking Enamel, Federal Spec. TT-E-489F, Color 13538.

3rd coat (Green Surface) - Dark Green Alkyd Urea Exterior Baking Enamel, Federal Spec. TT-E-489, Color 14062.

3rd coat (Flat Black Surface) - Alkyd Urea Black Synthetic. Heat-resisting Glyceryl Phthalate Type 4, instrument black military Spec. E-5557.

11. Installation. Mounting hardware shall be included in the Item furnished and shall be as indicated in Table 1327 for the signal mounting indicated on the plans. The installation and all hardware shall conform to the requirements of the details.

Signals shall be positioned over the center of the lane (s) specified except where offset positioning is indicated on the Plans.

Cost of furnishing and installing lamps shall be included in the bid price for the respective signal head.

1327.04 Pedestrian Signal Heads. Pedestrian signal heads shall conform to the ITE Specification "Adjustable Face Pedestrian Signal Head Standard," except as may be otherwise indicated below. The signal heads shall be of the light source type and legend lettering heights specified on the plans. Pedestrian signal heads shall be complete units made up of two optical compartments arranged vertically with no leakage of light from one compartment to another. The signal heads shall display alternately the legends "DON'T WALK" in Portland Orange light and "WALK" in Lunar White light.

1. Housing.

- a. Type A2 Pedestrian Signal - Material for the housing (s) and lens frames shall be of virgin ultra-violet stabilized polycarbonate resin. The housings shall be adequately reinforced and shall contain round serrated bossed openings in the top and bottom for mounting purposes.
- b. Type D2 Pedestrian Signal - Housing shall be single piece cast aluminum with 40mm (1-1/2") reinforced mounting hubs on the top and bottom with serrated bossed openings. Door frame shall be of one piece cast aluminum. Door shall be held closed by captive stainless steel wingnut and latching or unlatching of the door shall require no tools. Access to the lamps shall be direct by opening the door. All screws, nuts, bolts, and fastening devices used in each type signal housing shall be stainless steel.

All gaskets in each type housing which are exposed to the atmosphere shall be dust and moisture tight. The gaskets shall be neoprene or equivalent. Cork gaskets shall not be acceptable.

- 2. Dimensions.** Signal head face dimensions shall be as indicated in Table 1327.03.

TABLE 1327.03

Signal Type	Face Size mm (inches)				Legend Letter Size (inches)	
	Width		Height		Height	Stroke
	Min.	Max.	Min.	Max.	Nominal & Tolerance	Nominal & Tolerance
2 Sect.	28mm (11") Visible (min)					
12" Inc. Type A2	300 (12)	400 (16)	300 (12)	400 (16)	115±3 (4-1/2+1/8)	12mm±1mm (15/32+1/32)
18" Inc. Type D2	330 (13)	400 (16)	290 (15½)	450 (18)	115±3 (4-1/2+1/8)	12±1 (5/8-1/32 +3/32)

3. Arrangement of Letters and Colors. The color for "WALK" shall be Lunar White. The color for "DON'T WALK" shall be Portland Orange. Colors shall comply as fully as possible with color standards of the ITE Specification.

a. Type A2-2 Section, 12 inch incandescent Type Signal. The words "Don't Walk" shall appear in the upper section of the Signal Units in brilliant color by artificial illumination behind cutout letters in the lens. The word "Walk" message when illuminated. The letters shall be cutout type with black background and produce bright and uniform messages even in strong ambient lighting condition. When an optical section is not readable even under very strong ambient lighting conditions.

b. Type D2 Single Section Incandescent Type Signal. The face shall be of the three line type with "Don't Walk" in upper optic section and "Walk" in lower. The face shall be made of 6.5mm (0.250 inch) polycarbonate plastic and shall be textured on outside surface. The upper optical section shall display the two line "Don't Walk" message in Portland orange when illuminated and the bottom optical section shall display in white a single line "Walk" message when illuminated. The letters shall be cutout type with black background and produce bright and uniform messages even in strong ambient lighting condition. When an optical section is not energized, that section shall blank out so that the message is not readable even under very strong ambient lighting conditions.

4. Visor.

a. Type A2 Pedestrian Signal. The visor shall be of polycarbonate resin, securely attached to the housing. The visor shall be designed so that each message line is shielded from direct sunlight when the sun is 45 degrees or more above the horizon.

b. Type D2 Pedestrian Signal. The visor shall be of eggcrate design made 1mm (0.040") aluminum frame add 0.75mm (0.030") polycarbonate plastic louvers. The visor shall be 40mm (1-1/2") deep with horizontal members spaced 12mm (1/2") apart. There shall be enough vertical members to assure holding the horizontal members parallel. The visor shall be installed parallel to the face and mounted to the door frame by the use of stainless steel screws.

5. Painting. The signal head shall be painted in accordance with Item 1317 and the following:

The unit shall be properly cleaned and the exterior of the housing and the entire visor shall be given on coat of chromate primer and two coats of automotive baking enamel. Each coat shall baked individually to a hard finish.

Polycarbonate housing shall have the color impregnated in the resin material.

6. Optical. The optical part shall be made dust and moisture tight by the use of neoprene, or equivalent gaskets. Glass lenses for the face of the unit shall be heavy shock-resistant hammered glass at least 5.6mm (7/32 inch) thick. Plastic lenses for the face of the unit shall be impact resistant light diffusing plastic at least 3mm (1/8 inch) thick on type A2 and 6mm (1/4 inch) thick on Type D2 signals.

Polycarbonate lenses for the face of the unit shall be unbreakable under impact. The lenses shall be General Electric lexan or equivalent material.

For Type A2 Pedestrian Signals the lettering shall be on the inside face and the black or dark Gray opaque background shall not peel, craze or scratch under continuous exposure to sun, temperature, and humidity changes.

a. Reflector

1. **Type A2 Pedestrian Signal.** The reflector shall be of parabolic or similar shape which will distribute the light from the lamp evenly over the lens surface. The reflector shall not be rigid enough to maintain its shape accurately and shall be constructed from Alzak finished aluminum or other acceptable material with a mirror type finish.
2. **Type D2 Pedestrian Signal -** The optical system shall consist of two mirror like highly reflective parabolic reflectors designed to distribute the light uniformly over the entire lens surface with minimal return of outside light rays entering the unit from above horizontal (sun phantom). The lamp socket and reflector shall be constructed and mounted rigidly enough to maintain their shape and focus.

The optical systems shall be provided with a heat dissipation system to protect lamps from overheating. The two optical section shall be wired so that each section can be independently energized or de-energized without effect on the other section.

b. Socket. The socket shall be of porcelain, designed to properly position a medium screw base lamp in relation to the reflector. The socket shall be provided with lamp grip to prevent the lamp loosening due to vibration or other natural causes. On the type D2 Pedestrian Signal the socket shall be provided with a filament positioning device.

c. Lamps. Lamps for the type A2 and D2 Signal Heads shall be in accordance with Table 1326.01.

7. Optical Performance. It shall be possible to discern which message is illuminated and the message must be readable to normal eyesight from a distance of 30m (100 feet) on a bright, clear day, in direct sunlight, with the visor(s) removed.

8. Wiring. Each lamp receptacle shall be provided with two coded No. 18 or larger insulated copper lead wires connecting the lamps to the terminal strip. Wiring shall have approved 600 volt insulation, capable of withstanding 105°C and shall be long enough to provide easy accessibility without disconnection wires when the unit is opened for servicing.

9. Terminal Block. A terminal block having a minimum of seven terminals shall be located so as to be easily accessible when the unit is opened. Wires for interior connections to the external wiring shall terminate on this terminal block. Entry for external wiring shall be provided through both the top and bottom mounting hubs to the terminal block.

10. Installation. Mounting hardware shall be included in the item furnished and shall be as indicated in Table 1327 for the signal mounting indicated on the plans. The installation and all hardware shall conform to the requirements of the details.

11. Manufacturer. For the type D2 Pedestrian signals. The units shall be Indicator Controls Corporation Model 7037 without Clam shall mounting or approved equal.

1327.05 School Flasher, Installation Only. The work of this item shall consist of installing the school flasher assembly (consisting of the sign face, flashing amber beacons and illuminated speed numeral) which shall be furnished by the City.

The Contractor shall furnish and install the bracket arms of the length specified in the plans and all pole mounting hardware and all accessories required to install the school flasher complete.

All bracket arms shall be 40mm (1-1/2 inch) schedule 40 galvanized steel pipe. Galvanized pole plates shall be used with through bolts and leg screws on wood pole installations. Galvanized pole clamps shall be used on steel pole installations.

The installation shall not be in accordance with the Plans and details.

The school flasher time Control where required shall be furnished under Item 1324.06.

1327.06 Covering of Traffic Signals. Not in Service - New: All Signal heads which have been installed but are not in operation shall be kept completely covered at all times with burlap, heavy corrugated cardboard, or other approved material, so that the signal lenses are not visible from any point. Lamps in signal heads covered with cardboard, burlap, etc., shall be removed or de-energized until the covering is removed and the signals are put into operation.

To Be Removed or Temporarily Disconnected: When removed or temporarily disconnected from operation existing signal heads shall be covered with burlap, heavy corrugated cardboard, or other approved material and lamps shall be removed or de-energized until the signal heads are removed or restored by the Contractor. Existing signal heads shall not be removed until the new equipment is in operation.

Payment for covering of traffic signals shall be incidental to the various items of bid which require new, removed or temporary signal equipment.

Coverings shall be provided for vehicular, lane use and pedestrian signal heads.

1327.07 Method of Measurement. Signal heads shall be measured as complete units in place and accepted, and shall include all support and mounting hardware, optical programming as specified, aiming, lamps are required, tether cable as specified and covering.

1327.08 Basis of Payment. Payment will be made at the contract unit price bid for each signal head as specified, and shall include all labor, material, tools, equipment, and incidentals necessary to furnish and install the item complete, tested and accepted.

Item	Unit	Description
1327	Each	Vehicular Signal head, assembly ____ Section, ____ inch lens, ____ way.
1327	Each	Optically programmed Signal head assembly ____ Section, ____ inch lens, ____ way.
1327	Each	Lane Use Control Signal head assembly ____ Controlled ____ face.
1327	Each	Lane use control signal head assembly, ____ inch ____ lens, ____ way.
1327	Each	Pedestrian Signal head assembly, ____ type ____.

ITEM 1328 - TRAFFIC SIGNAL DETECTORS

1328.01 Detector Amplifier, Installation Only

1328.02	Detector Pavement Cutting
1328.03	Loop Detector Installed in Duct
1328.04	Magnetometer Probe with Cable, Installation
1328.05	Magnetometer Probe Splice
1328.06	Magnetometer Installed in Duct
1328.07	Pedestrian Pushbutton With Signs
1328.08	Pressure Sensitive Detectors
1328.09	Method of Measurement
1328.10	Basis of Payment

1328.01 Detector Amplifier, Installation Only. The work of this item shall consist of hauling and installing loop and/or magnetometer detector amplifiers as specified, furnished by the City of Cincinnati, in accordance with the plans and details. The amplifiers shall be installed in the traffic signal controller cabinet, or separate cabinet if specified, and all wiring connections shall be in accordance with the details.

1328.02 Detector Pavement Cutting. Slots shall be sawn in the pavement, for installation of wire for vehicle detector loops and/or magnetometer detectors in accordance with the configuration dimensions, and combinations shown on the plans. Before saw cutting the slot 30mm (1-1/4") diameter drilled holes shall be made in the pavement at each intersection of saw cuts to prevent sharp bends of the wire. The intersection of saw cuts shall overlap so that the slots have full depth and a smooth bottom. When installing the detector loop, the weather shall be clear and dry and the sawed slot shall be completely clean of dust and debris and thoroughly dry. An extension from the loop or magnetometers to the pavement edge shall be cut to permit wire routing to an adjacent pullbox or conduit fitting. When going through curbs Item 1321.04 PVC conduit shall be used to take the wire from the pavement edge through the curb and on into the pullbox or conduit fitting. Where no curb is present the sawcut shall end 150mm (6") before the pavement edge at which point the wire shall be routed through Item 1321.04 PVC conduit to an adjacent pullbox or conduit fitting.

Slot width shall be 10mm (3/8 inch) and a slot depth shall be 100mm (4.0 inches) in asphalt and 50mm (2 inches) in concrete with the minimum depth providing a covering above the upper most wire in the slot of no less than 25mm (1") in concrete and 75mm (3 inches) in asphalt. If floating of the wire occurs 25mm (1 inch) of 6mm (1/4 inch) O.D. vinyl tubing should be bent and wedged into the slot to keep the wire down at two foot centers. Following pavement cutting and cleaning, the detector wire shall be installed according to Item 1323.01.

Where the saw cut crosses any construction joint or cracks in concrete or asphalt pavement, the Contractor shall drill a 40mm (1-1/2 inch) diameter hole at the joint and provide a relief loop for the detector wire. Installation methods and materials shall be as indicated on the details.

Slots shall be sealed with a flexible embedding sealant approved by the City Traffic Engineer and as indicated on the details. Sealant shall be an epoxy type; "Goldflex" as manufactured by Preco., or an approved equal. Before sealant

application all slots shall be brushed or blown clean of loose material and shall be completely dry. The sealant shall be mixed and placed according to the manufacturer's instructions. The slots shall be filled completely and left undisturbed until cured. Excess or spillage must be removed.

Detector wire installations in new asphalt may be sawn and embedded with sealant in an undersurface course with subsequent covering by the surface course, subject to the approval of the Engineer. Detector wire installations shall not be made in existing brick or unstable bituminous roadways.

The Contractor shall test the loop detector wire in accordance with Item 1313 before and after loop sealant is applied.

Payment for the sealant shall be included in the Item of Saw Cutting.

1328.03 Loop Detector Installed In Duct. The Work of this item shall consist of installing conduit in areas trenched for this purpose or under new concrete roadway which ever is specified in the plans.

Where the plans require installation of duct in trenched areas, the work shall include Item 1321.02 trenching in paved areas to the depth and width specified and installing Item 1321.04 inch PVC conduit Type I concrete encased, formed in the dimensions specified on the plans. Loop detector wire shall be multi-conductor traffic signal cable, as specified on the plans and details, installed in the conduit and spliced to form multi-turn loops in the specified pullbox or conduit fitting. Loop detector wire shall be a separate pay item. This work shall also include restoration of the paved area in accordance with Item 1334.

Where the plans require installation of duct under new concrete roadway, the work shall include Item 1321.04 2.5mm (1 inch) PVC conduit Type II, formed in the dimensions specified on the plans and shall include the applicable Item 202 for removing and disposing of existing pavement and Item 451 for installing new concrete pavement without reinforcing where these items are not included under roadway items. Additional items may be required contingent on the conditions and shall be specified.

Payment may be made for each item required or on a lump sum basis and shall be specified.

1328.04 Magnetometer Probe with Cable, Installation Only. The work of this item shall include installing magnetometer probes with cable, which shall be furnished by the City, in accordance with the plans, and details.

Magnetometer probes are normally supplied with 15 to 30m (50 or 100 feet) of Probe Cable for connection to lead-in cable or Amplifier. Multiple probes are supplied with 15m (50 feet) of Probe Cable. The probe cable shall be used so as to be sufficient to reach the nearby pull box, "C" fitting or detectors cabinet, whichever is required by the plans.

Where splicing is required, splices shall be made in accordance with Item 1328.05 in pullboxes or "C" fittings.

The detector probes shall be installed by drilling 25mm (one inch) diameter holes to a depth of 350mm (14 inches) below grade at the specified location according to the plans and details. This work shall include backfilling the holes seating the probes with sand or fine saw cut sealant or trench fill.

The probe cable shall be layed carefully in sawcut or roofed through the conduit as specified and connected to the lead-in cable in a pullbox or "C" fitting or to the detector amplifier which ever is indicated on the plans.

1328.05 Magnetometer Probe Splice. Splices where required shall consist of soldering all wiring connections and encapsulating the connections with a waterproof splicekit.

Waterproofing splice kit shall be of the heat shrink tube with internal gel type. Kits shall be approved by the City Traffic Engineer.

1328.06 Magnetometers Installed In Duct. The work of this item shall consist of trenching in paved areas in accordance with Item 1321.02. The trench shall be 150mm (6 inches) wide by 150mm (6 inches) deep along the line of magnetometers and probe cable from the pullbox or roadside as indicated on the plans. The detector probes are installed in accordance with Item 1328.04.

A 30mm (1-1/4 inch) PVC Type I conduit, per Item 1321.04, shall be installed in the trench and cut to allow openings for magnetometer probe installations.

The trench is then filled with concrete Class "C" to 50mm (two inches) below the street surface. After the concrete sets, the remainder of the trench is filled, compacted, and sealed with material similar to the street surface.

The Contractor shall dispose of excavated material and the restoration of the paved area shall be in accordance with Item 1334.

1328.07 Pedestrian Pushbutton With Signals. Pushbuttons shall be of sturdy two-piece construction, consisting of a base housing and a removable cover assembly with all other parts attached. The components assembled on the cover shall provide a thumb sized and slightly recessed pushbutton with normally open contacts and shall include all electrical and mechanical parts required for operation. Electrical circuitry, although normally operated at a low voltage for pedestrian protection, shall be suitable for use at 120 volts for testing purposes. The button shall not be removed without removing the cover housing.

The housing and cover shall be cast aluminum alloy of adequate strength. The housing shall have a curved back surface for mounting on poles of various diameters. The curved surface may be integral with the housing or may be on an adaptor supplied with a flat back type housing. The cover assembly shall be attached to the housing by stainless steel machine screws, resulting in a weatherproof and shockproof design. A hole threaded for a 12mm (1/2-inch) pipe shall be provided in the housing upper and/or lower sides for conduit attachment purposes.

Pushbuttons shall be oriented as shown on the plans. Pushbuttons mounted on steel poles shall be serviced by wiring inside the poles, as detailed. Holes 20mm (3/4 inches) in diameter shall be provided throughout the back of the housing and the pole wall, an insulated bushing installed, and wiring routed through so that no external wiring is visible. The unused conduit attachment hole(s) shall be plugged. Housing mounting shall be as shown on the details. Pushbuttons mounted on wooden poles shall be serviced through conduit and mounted as shown on the plans.

Pushbuttons shall be furnished with two (2) instruction signs, one mounted adjacent to the pushbutton and one mounted across the street on the complemented actuated pedestrian signal. Mounting details and locations shall be as shown on the details and the plans.

The sign adjacent to the pushbutton shall be an R-73A-MOD-5, nominally 125mm x 200mm (5 inches x 8 inches) and shall contain the legend: "TO CROSS STREET PUSH BUTTON WAIT FOR WALK LIGHT" arranged as shown on the plans.

The sign adjacent to the signal shall be an R-73B-MOD-18, nominally 450mm x 600mm (18 inches x 24 inches) and shall contain the legend: "PUSH BUTTON FOR WALK LIGHT" arranged as shown on the plans.

Signs shall meet the requirements of Item 1329.03.

1328.08 Pressure Sensitive Detectors. Pressure sensitive detectors shall be of the 2m or 2.5m (6 or 8 foot) long size as specified and shall be equipped with frame, pad and enclosed contact unit for mounting in the roadway flush to the surface.

When installed in their frames, contact pads have a smooth surface of tough, specially compounded rubber for traffic service with no projecting nuts, bolts or screws. Design of frame and contact unit shall allow pad and/or contact unit to be replaced without disturbing the frame or pavement in which the frame is embedded.

The frame shall contain a weatherproof splice box with a normally opened contact unit operating on low voltage (i.e.) 12 volts + or -) and with one end of the contact unit grounded to provide a ground pulse upon vehicle actuation.

The frame shall be designed for maximum strength and to assure security of anchorage when embedded in the roadway.

Where specified, the type HR shall be provided with a contact unit for detecting vehicles passing in over the cover in either direction. This type shall be capable of detecting vehicles up to 100km/hr. (60 m.p.h.). Where specified, the type HRD shall be provided with a contact unit with the capability of directionally detecting vehicles up to 60km/hr. (35 m.p.h.).

Models HR & HRD refer to detectors manufactured by the Automobile Signal Division of the LFE Corporation.

The Contractor shall provide a 3 conductor or 3 separate conductors of No. 12 AWG Type RHW/USE cable, from each pressure detector to the controller cabinet. Electrical connections between detectors shall be made only at the controller cabinet or other as specified.

Dimensions shown on the plans refer to the location of the contact element, and do not include the splice box at one end.

Where directional detector type units are specified, the City will furnish and the Contractor shall install a directional relay for connection to the cable.

Excavation in the paved areas shall be to the dimensions shown on the details. When installing the detector, support the frame with temporary wood supports and fill the exposed areas with Class "C" Concrete. Wood supports may be removed after 24 hours and when the concrete has set. Install PVC conduit Type II per Item 1321.04 to the specified pullbox.

Provide a drain as shown on the details and dispose of all excavated material.

The detector shall be installed and the concrete encasement shall be finished flush to paved surface.

1328.09 Method of Measurement. Detector amplifiers shall be measured as complete units in place, connected, tested and accepted.

Detector pavement cutting shall be measured as the total number of meters (feet) of slots from the edge of the pavement to the magnetometer probe locations or to the loop and around the loop perimeter using the overall dimensions and making no adjustments for the diagonal corners. The work shall include the application of sealant, and cleaning and blowing out the slotted areas.

Magnetometer sensor probes shall be measured as individual units in place and accepted, and shall include probe and cable installation. This shall include drilling and backfilling over each probe and routing probe cable through conduit

in trenching applications. Payment for saw cutting, sealant and cleaning slotted areas or for furnishing conduit shall be under the respective bid item.

Loop detector installed in duct shall be measured as more than one specified pay item (i.e. conduit, trenching paved areas, concrete, or conduit, excavation and new pavement). The measurement would then be comprised of each of the items specified

OR

Loop detector installed in duct shall be measured as a complete item per m² (square foot) of area for installations under new pavement or as meters (linear feet) excavated and restored. For installations in trenched areas each detector shall include all conduit trench-paved areas, excavation, restoration and concrete Class C as required. Payment would be made as "Loop Detector Installation".

Magnetometers installed in duct shall be measured as more than one specified pay item (i.e. probes with cable, conduit, and trenching in paved areas). Measurement would then be comprised of each of the items specified.

Pedestrian pushbutton with signs shall be measured as a complete unit in place, including all hardware, tested and accepted.

Pressure sensitive detectors shall be measured as a complete unit in place, including excavation, restoration with Class C concrete, conduit and testing and acceptance.

1328.10 Basis of Payment. Payment will be made at the contract unit price bid as specified per each item and shall be full compensation for all labor, materials, tools, equipment and incidentals necessary to furnish and install the items as specified, complete, tested and accepted and in accordance with the details.

Item	Unit	Description
1328	Each	___ detector amplifier, installation Only
1328	m (Ft.)	___ detector pavement cutting
1328	m ² (Sq.Ft.)	___ Loop detector installation, with new pavement
1328	m (Ft.)	Loop detector installation in trenched area
1328	Each	Magnetometer probes with Cable, installation Only
1328	Each	Magnetometer probe splice
1328	Each	Pedestrian pushbuttons with signs
1328	Each	Pressure sensitive detector, ___ type ___ long.

ITEM 1329 - TRAFFIC CONTROL SIGNS AND INSTALLATIONS

- 1329.01 Internally Illuminated Signs
- 1329.02 Mechanically Operated Vane Type Signs
- 1329.03 Signs, Flat Sheet Type
- 1329.04 Sign Attachments
- 1329.05 Sign Post Foundations
- 1329.06 Steel Drive Posts
- 1329.07 Method of Measurement
- 1329.08 Basis of Payment

1329.01 Internally Illuminated Signs. This work shall consist of furnishing and installing internally illuminated signs with one or more plastic faces in accordance with these specifications and as shown in the plans and on the details.

1. Definitions.

Signs - Shall mean the entire assembly including frame, permanently attached aluminum face for single faced sign, mounting hubs, top frame reinforcement, lamps, lamp holders, ballasts, terminals, and wiring.

Frame - Shall mean the members forming the top, ends and bottom enclosure of the sign.

Faces - the sides of the sign that face traffic.

Plastic Face - shall be the entire assembly of plastic and paint forming the complete sign face.

Background. - shall be the main panel of plastic which slides into the U grooves of the sign case and on which all specified legends are placed.

Legend - letters, numbers, emblems, route markers, lines and/or arrows forming in message.

- 2. **Design.** The illuminated sign shall be an all-aluminum box designed and constructed so the sign, complete with face or faces, will hang plumb when suspended.
- 3. **Cast-Mechanical Construction.** All metallic parts shall be of aluminum of at least 0.25mm (0.100 inches) thick at all points. The aluminum shall be of high strength alloy type at least equal in strength and abrasion resistance to 3003H14.
 - a. **Wind Load.** The material, design and construction shall be such that the case will withstand continuous wind loads up to 1500 Pa (30 lbs. per sq. ft.).

- b. **Construction.** The case shall be of the size shown on the plans and Table 1329A a single faced sign shall be designed for one plastic face and one permanently attached aluminum face. A double faced sign shall be designed for two plastic faces. Plastic faces shall be retained in "U" shaped tracks designed to permit easy removal of the faces by sliding them out of the case on side or at the bottom for legend changing and electrical maintenance.

TABLE 1329A - SIGN DIMENSIONS AND MECHANICAL DATA

Size Designation	Case Inside Diameter Nominal - Inches Shall be Modified to Accommodate Tube Length		Frame Cross Section Flange Depth Inches		Overall Thickness of Complete Sign Inches		Number of 1 1/2 inch Pipe Size Mounting Hubs (c)	Ballast Code No. (a)	Lamp Code	No. of Lamps (b)
	Horizontal	Vertical	Min.	Max.	Min.	Max.				
24" x 24" or 24" x 24"D	24	24	5/8	3/4	5	8	1	256-681	F24T12CW	3
24" x 30"	24	30	5/8	3/4	5	8	1	256-631	F24T12CW	4
24" x 30"	24	30	5/8	3/4	9 1/2	10 1/2	1	2 ea. 256-971-200	F24T12CW/HO	8
30"BO(D)	30	24	5/8	3/4	5	8	1	256-631	F24T12CW	4
30" x 24"	30	36	5/8	3/4	5	8	1	256-631	F36T12CW	4
36" x 30"	36	30	5/8	3/4	5	8	2	256-631	F36T12CW	4
36" x 36" 36" x 36"D	36	36	5/8	3/4	5	8	2	256-631	F36T12CW	4
42" x 36"	42	36	5/8	3/4	5	8	2	1 ea. 256-601 1 ea. 256-681	F36T12CW	5
48" x 30"	48	30	5/8	3/4	5	8	2	256-631	F48T12CW	4
48" x 36"	48	36	5/8	3/4	5	8	2	256-631	F48T12CW	4
48" x 48" 48 x 48"D	48	48	5/8	3/4	5	8	1	2 ea. 256-681	F48T12CW	6

(a) Numbers are those of the Jefferson Electric Company stated as a guide only.

(b) Lamps mounted vertically or at 45° from vertical shall have a rubber sleeve at the bottom lamp base.

(c) A mounting hub for mounting on a 4 inch post is required on the bottom and/or bottom corner of the sign.

(d) Measured with plastic at 70° F.

(e) Diamond shaped signs (with D on size designation) are square turned at 45° angle.

(f) BO designation indicates blankout type sign.

TABLE 1329B - SIGN FACE DIMENSIONS

Size Designation	Visible Plastic Face Area (Minimum, Inches)		Plastic Face Dimensions - Inches				Plastic Face Thickness		Plastic Face Corner Radius-Inches
			Horizontal		Vertical				
	Horizontal	Vertical	Min.	Max.	Min.	Max.	Min.	Max.	
24" x 24" or 24" x 24"D(c)	22½	22½	23 11/16	22½	23 11/16	23¾	0.125	0.150	1½
24" x 30"	22½	28½	23 11/16	23¾	29 11/16	29¾	0.125	0.150	1½
30" x 24"	28½	22½	29 11/16	29¾	23 11/16	23¾	0.125	0.150	1½
30" x 36"	28½	34½	29 11/16	29¾	35 5/8	35 11/16	0.125	0.150	1½
36" x 30"	34½	28½	35 5/8	35 11/16	29 11/16	29¾	0.125	0.150	1½
36" x 36" 36" x 36"D(e)	34½	34½	35 5/8	35 11/16	35 5/8	35 11/16	0.187	0.200	1½
42" x 36"	40½	34½	41 9/16	41 5/8	35 5/8	35 11/16	0.187	0.200	1½
48" x 30"	46½	28½	47 9/16	47 5/8	29 11/16	29¾	0.187	0.200	1½
48" x 36"	46½	34½	47 9/16	47 5/8	35 5/8	35 11/16	0.187	0.200	1½
48" x 48" 48" x 48"D(e)	46½	46½	47 9/16	47 5/8	47 9/16	47 5/8	0.187	0.200	1½

- (a) Numbers are those of the Jefferson Electric Company stated as a guide only.
 (b) Lamps mounted vertically or at 45° from vertical shall have a rubber sleeve at the bottom lamp base.
 (c) A mounting hub for mounting on a 4 inch post is required on the bottom and/or bottom corner of the sign.
 (d) Measured with plastic at 70° F.
 (e) Diamond shaped signs (with D on size designation) are square turned at 45° angle.
 (f) BO designation indicates blackout type sign.

The frame shall be of an extrusion, casting, or formed member having one piece cross section with flanges on both ends. It shall be at least as rigid as an extrusion of this design. The flanges shall be of "U" type specified for plastic faces and of either the "U" type or the single flange type for attachment of the aluminum sheet for the blind side of single faced signs. The frame and aluminum faces shall have continuously welded seams and shall be watertight.

The flanges serving as retainers for all faces shall have a radius of 40mm (1-1/2 inches) at each corner of the sign. The top of the case frame shall be reinforced with a piece of 3mm (1/8 inch thick) aluminum, continuously welded to the inside of the frame, extending the full width inside the frame flanges and running the full length of the frame top. All 24 x 24D, 36 x 36D and 48 x 48D signs shall be reinforced with 3mm (1/8 inch) thick aluminum continuously welded to the inside of the frame extending the width inside the frame flanges and extending up each side, at least 450mm (18 inches), from the bottom corner. This welded reinforcement is to reinforce the top to prevent deformation caused by the stress induced through the mounting hubs when installed.

Four 5mm (1/4 inch) weep holes shall be drilled, two on each end of the bottom of the frame, except on the 24 x 24D, 36 x 36D, and 48 x 48D signs which shall have two weep holes drilled in the bottom corner.

4. Mounting. There shall be attached to the top of the frame the number of 40mm (1-1/2 inch) pipe size flanged pipe hubs specified in Table 1329A for mounting purposes. The size 24 x 24D, 36 x 36D and 48 x 48D sign shall have the hubs attached to a waterproof bracket assembly welded to the sign at the top corner to allow suspension of the sign in a diamond shaped configuration (square turned at 45° angle). The hubs shall be attached with nut and bolts, and the flange to bracket shall be gasketed.

The hubs shall be painted the same color as the frame with the threads not be painted and the cable entrance shall be through the hubs.

5. Fastening Devices. All nuts, bolts, screws, and rivets shall be of stainless steel or high strength silicon bronze.

6. Brightness. Brightness readings shall be made at 118 input line voltage after the first 100 hours of lamp operation with a white plastic face of ROHM & HAAS Plexiglass No.7328 of the thickness specified in Table 1329B.

The plastic face shall be divided into 100mm x 100mm (4 inch by 4 inch) rectangles and one reading taken in the center of each rectangle. Readings shall be made in foot lamberts.

AVERAGE BRIGHTNESS - (B_{AVG}) - shall be the sum of the individual brightness readings divided by the number of readings taken.

MAXIMUM BRIGHTNESS - (B_{MAX}) - shall be the largest reading taken.

MINIMUM BRIGHTNESS - (B_{MIN}) - shall be the smallest reading taken.

RANGE OF AVERAGE BRIGHTNESS - (R) - a percentage

$$R = 100 \frac{B_{MAX} - B_{MIN}}{B_{AVG}}$$

VALUES - THE VALUES SHALL BE AS FOLLOWS:

	MIN.	MAX.
Average Brightness (B_{AVG})	130	190
Range of Average Brightness (R)		55

7. **Component Mounting.** The mounting of components inside the sign shall be such that no shadows or dark spots appear on the sign face when the sign is illuminated.
8. **Lamps.** (Signs shall be furnished with lamps.) Signs shall be designed for use with standard universally available T-12 cool white slimline fluorescent lamps in accordance with Table 1329A.
9. **Lampholders.** Lampholders shall be of white high impact plastic or porcelain single pin contact type. Lampholders at the low voltage end of the lamp shall be of the short-circuiting type, and at the high voltage end shall be rated at not less than 600 volts. At the low voltage end, the lampholder shall be wired with the ground conductor so that the primary circuit of the ballast will be opened when any lamp is removed. If the lampholder on only one end of a lamp has a spring, the spring shall be in the top lampholder for vertically mounted tubes.
10. **Ballast.** The ballast shall meet the requirements of ANSI standard C-82-1 and C-82-2 and shall be of the rapid or instant start type. The ballast shall be of the lead-lag type designed to give the performance specified herein with the number of lamps specified and shall be in accordance with Table 1329A. The ballast shall have a power factor of at least 90%, and shall be designed for outdoor use in a weather resistance enclosure giving reliable starting at all ambient temperatures above -7°C (20°F).

The ballast shall be marked with the following:

Manufacturer's name or trade mark and catalog number.

Input voltage, frequency and current rating.

Open-circuit voltage, power factor and ballast loss (watts).

Number of lamps, nominal lamp current, lamp length and type.

Wiring diagram indicating the correct electrical connection of various leads.

The ballast when located on the bottom of the sign shall be mounted on spacers to provide 12mm (1/2") clearance with the bottom and shall be bolted to the bottom of the case by four bolts. The ballast when located in other positions in the case shall be located to minimize the effect of the weight of the ballast on the balance of the sign and the ability of the sign to hand plumb.

11. **Terminal Block.** A terminal block having a minimum of four (4) terminals shall be located near the cable entrance. Wires for interior power connections shall terminate on this terminal block. No external wires shall be supplied.
12. **Wiring.** The wire shall be an appliance Wire No. 18, AWG, with at least 16 copper strands and with thermoplastic insulation at least 0.8mm (2/64") thick and insulation rated for 105°C. All wires shall be color-coded with white used for the ground wire and color-coded wires for the ungrounded wires of the supply circuit. The secondary circuit or high voltage circuit shall correspond to the color coding of the ballast leads.

Wire shall be run neatly in an aluminum raceway or flexible aluminum conduit and the edges of the openings in sheet metal or conduit shall offer protection from abrasion by means of a bushing grommet or rolled edge. The conduit shall be securely clamped or reliably held in place at all openings and the wiring shall be supported so that the bottom of a sign is cleared by not less than 12mm (1/2").

Splices shall be mechanically and electrically secure and made with an acceptable splicing device.

Ballast lead splices shall be confined to the ballast junction boxes and the raceway.

The insulation on the wires at connection points shall not be stripped back any further than is necessary. Bare conductor shall not overhang the edge of the base to which it is connected. Wires fastened to lampholder terminals shall be mechanically and electrically secure.

13. **Marking.** Each sign case shall be marked on an inside surface with the manufacturer's name and the date manufactured.
14. **Painting.** The interior and exterior of the case shall be primed and shall receive two coats of an alkyd enamel of the industrial exterior baked dry type. The unit shall be baked after each coat.

EXTERIOR - shall be finished Dark Green No. 14062 in accordance with Federal Standard No. 595. The inside of the visor (BO Type) shall be Flat Black.

INTERIOR - shall be furnished with a non-yellowing White.

15. Plastic Face.

- a. **Material.** The face shall be of cast translucent plastic of acrylic resin type matching the following Rohm and Haas Plexiglass Nos. in weathering, structural, and optical properties or a Lexan material where specified.

White	W 7328
Yellow	2016

Material shall be of the thickness specified in Table 1329B.

- b. **Legend.** A painted legend shall be applied using a brand of paint specified by the plastic manufacturer and shall be applied using the silk screen or spray latex process. Over the painted legend shall be applied a clear protective coating of a brand specified by the plastic manufacturer. Face designs and colors shall be as shown on the details.

Black painted, legends, when specified, shall be opaque.

Red, green and blue painted legends, when specified, shall be translucent, of a type which will transmit an amount and color of light which is not distinguishable from the light transmitted by the materials specified.

The red, green and blue painted legend, when specified, shall match the following Rohm & Haas numbers in optical properties:

Red	2214
*Green	2280
Blue	2114

*Except street name signs (see Paragraph 17).

16. **Blank Out Type Sign.** The blank out sign shall be designed to cause the specified legend to be blanked out (effectively disappear) when electric power is de-energized.

The sign face shall be mounted on a hinged gasketed door with a 150mm (6 inch) sun visor attached to the door at the top and two sides.

An aluminum light-directing louvered screen shall be installed in front of the face to prevent entrance of sunlight into the sign face.

The sign legend shall be displayed by the projection of internal illumination through the unpainted portion of the sign face.

The sign face shall be of a clear (transparent) legend with a black background. The background shall be painted on the inside surface of the sign face.

17. **Street Name Signs.** Street name sign faces shall be Lexan or approved equal. The text shall consist of white letters on a dark green background. The white letters and numbers shall require a vinyl type translucent paint. The background dark green shall conform to Federal Color #14109.

18. **Installation.** Mounting hardware shall be included in the item furnished and shall be as indicated in Table 1327 for the mounting arrangement indicated on the plans. The installation and all hardware shall be in accordance with the requirements of the details.

1329.02 Mechanically Operated Vane Type Signs.

1. **General.** The sign shall consist of two electrically driven hinged outer panels (vaness) which close over a center panel or open to expose the sign face. The outer panels open and close through 180°.

The "Blank Out Type" shall be a single message type so that when the outer panels close over the center panel, no message is visible. When the outer panels open, both the outer and center panels form the specified sign face.

The "Dual-Message Type" shall be a two message type so that the movable panels when open form one sign face with the center panel as the open blankout type and when the movable panels close over the center panel, form a second message with the extended portion of the center panel. This type required that the center panel be extended to line up with the opened movable panels and with the movable panels painted on both sides.

2. Sign Face Blank an Panels. The sign face and panels shall be a Minimum 3mm (0.125 inch) thick 6061-T6 aluminum with radius corners. The aluminum shall be properly degreased and etched or treated with a light, tightly adherent amorphous chromate conversion coating, free of any powdery residue, ranging in color from silvery iridescent to a pale yellow, conforming to ASTM B449-67, Class 2, 10-35 mg/sq.ft. with a median of 25 mg/sq.ft. as the optimum coating weight. The sign shall form an essentially plan surface when opened.

3. Sign Face. The sign when opened, or closed, if dual messages shall accommodate the standard designs of Manual on Uniform Traffic Control Devices. Sizes shall be 24" x 24", 24" x 30", 30" x 30", 30" x 36" as specified. Message, border and background color shall conform to the Manual on Uniform Traffic Control Devices.

The face shall be reflectorized with the sheeting. Painted and sealed with a clear coating.

4. Frame. The frame shall be 6mm x 25mm x 25mm (0.250 inch x 1 inch x 1 inch) 6061-T6 aluminum angle with 3mm (0.125 inch) aluminum brackets with standard hub holes and one wire hole. Frame and brackets shall be of welded aluminum construction.

Sign activating mechanism shall be enclosed in a corrosion resistant box, constructed of a minimum of 1.5mm (.060 inch) 3003 H-14 aluminum with a housing cover of minimum 3mm (0.125 inch) 300 H-14 aluminum. The enclosure shall meet NEMA 3R requirements for raintight applications.

5. Working Mechanism. The mechanical drive mechanism shall consist of a roller chain drive, cam driven, self locking device with positive drive on both cycles with spring override. All working parts shall be cadmium plated steel. Motor shall magnetic brake non reversing, gear reduction type, 115 volts 3 amp developing minimum torque of 230N.m (170 lbs.) at 6-8 RPM and shall have direct drive from output shaft to operating cam. A microswitch shall be provided and shall be rated for 15 amps at 115 volts.

The motor shall be enclosed by a galvanized steel cover positioned below the sign drive mechanism, with the gear reduction drive shall protruding through the housing to connect with the cam.

All screws, bolts, nuts, sprockets and washers shall be cadmium plated steel.

Chain drive shall be 6.5mm (1/4 inch) pitch cadmium plated steel rolled chain.

Hinges shall consist of three pivot points on each panel. Pivots shall be of cadmium plated steel, attached with bolts to threaded holes to the panels, and shall have brass bushings.

6. Mounting. The mounting assembly shall consists of mounting brackets or hubs, with 38mm (1-1/2 inch) pipe arms and "U" or saddle clamps for securing the sign assembly to a post or drop pipe (with weather head) as specified in the plans.

There shall be at least two mounting assemblies and the material shall be constructed as follows:

A. U-Clamp - Constructed of 5mm (3/16 inch) cadmium or zinc coated steel and bracket with formed radius as specified with 12mm (1/2 inch) "U" bolt of welded construction or painted cast iron of equal strength and design.

OR

B. Sign Mounting Clamp - Shall be welded construction with 10mm (3/8 inch) "U" bolt and full grip clamp, with 1-1/2 inch standard tubing and 10 gauge steel plate or cast iron of equal strength and design with standard hub hole pattern.

Hub - Plate shall be 10 gauge steel or cast iron of equal strength and design with standard hub hole pattern, welded 40mm (1-1/2 inch) standard pipe collar or nipple.

Where span wire or mast arm mounting is specified, the Contractor shall provide a 40mm (1-1/2 inch), schedule 40, galvanized steel pipe of the length required, a weatherhead and balance adjuster and span wire suspension clamp or mast arm bracket. The assembled sign shall be installed as shown on the details.

7. Miscellaneous Requirements.

The complete sign unit shall weigh not more than 25kg (55 lbs.).

The open or closure time through 180° shall be less than 6 seconds.

The mechanism shall be enclosed and protected to function in wide range of environmental conditions including rain, snow, wind and temperatures from -40°C-70°C (-40°F to 150°F).

The sign shall not normally require periodic lubrication, cleaning or seasonal adjustment.

The sign shall not be damaged by forcing the panels open or closed within normal operating range.

1329.03 Signs, Flat Sheet Type. Signs which are not required to be internally illuminated shall be of the flat sheet type fabricated from aluminum, painted and reflectorized in accordance with Item 630.

Signs shall be in accordance with the standard designs of the Manual on Uniform Traffic Control Devices and of the size and legend as indicated on the plans and details.

Payment for mounting hardware and installing signs shall be made under the specified attachment.

1329.04 Sign Attachments.

1. General. The work of this item shall consist of furnishing and installing the sign provided under Item 1329.03, with the hardware as specified for the type mounting attachments. The sign and attachment assembly shall be installed in accordance with the plans and details.

2. Span Wire Mounted Sign Attachments. The work of this item shall include steel drop pipe, span wire suspension clamp, weatherhead and balance adjuster, lead slug, pipe cap, and pipe straps and hardware.

3. **Pole Mounted Sign Attachments.** The work of this item shall include brackets, banding and hardware.
4. **Mast Arm Mounted Sign Attachments.** The work of this item shall include steel drop pipe, lead slug, pipe cap and straps, mast are clamp and hardware.
5. **Bridge or Wall Mounted Attachments.** The work of this item shall include angle brackets, anchoring hardware and miscellaneous hardware.
6. **Plaque Attachments.** Where a reflectorized sign (or plaque) is specified to be attachment to an illuminated sign and/or traffic signal head, such sign attachment, which includes all hardware required for the attachment, shall be incidental to the payment of the illuminated sign and/or traffic signal head.

Payment and quantity for the reflectorized sign shall be indicated in the sign notes and quantities.

7. **Materials.** All hardware and materials required shall be of the non-corrosive materials as specified in the details.

1329.05 Sign Post Foundations. Sign posts shall be cast in Class "C" concrete in accordance with the details. Cylindrical foundations for ground mounted sign supports shall have the concrete placed with the support braced in a vertical position until the concrete has set. The foundation top surface shall be sloped to provide for drainage.

This work shall include excavating and backfilling and disposal of surplus material and braces.

1329.06 Steel Drive Posts. This work shall consist of furnishing and installing Number 3 posts. These posts shall be fabricated as per 712.20 and shall include necessary hardware.

1329.07 Method of Measurement. Internally illuminated and mechanically operated vane type signs shall be measured as a complete unit in place, including all lamps (for illuminated signs), sign faces with the specified legend(s), all components and mechanisms and all mounting hardware.

Signs, flat sheet type, shall be measured as the actual number of square feet of signs furnished, erected, and accepted. Measurement for square, rectangular, circular, or irregular shaped signs will be determined by multiplying the largest dimensions of width and height. Measurement for triangular shaped signs will be determined by multiplying the largest dimension of width and one-half the largest dimension of height.

Sign attachment assemblies shall be measured as complete units by type furnished and installed complete in place and accepted with the specified sign(s) included but furnished under its own item of payment. This shall include all clamps, pipes, hangers, brackets, hardware and incidentals as indicated for each type.

Foundation concrete for sign posts shall be measured as the number of cubic yards as determined by calculations from plan dimensions, in place, complete and accepted, and will include excavation, bracing, concrete, backfilling, and disposal of surplus excavation. No deduction will be made for the volume within the concrete of beams.

Steel drive posts shall be measured as the actual number of linear feet furnished and erected in place, complete and accepted. The supports will include driving if specified, sign backing assemblies and soil plates with assembly hardware when required, and the furnishing of patching materials for excavations in paved areas.

1329.08 Basis of Payment. Payment will be made at the contract unit price bid as specified per each item and shall be full compensation for all labor, materials, tools, equipment and incidentals necessary to furnish and install the items as specified, complete, tested and accepted.

Item	Unit	Description
1329	Each	Internally illuminated sign, ___ face, ___ inches x ___ inches
1329	Each	Mechanically operated vane type sign, ___ type, ___ inches x ___ inches
1329	m ² (Square foot)	Signs, flat sheet type
1329	Each	___ mounted sign attachment
1329	m ³ (Cubic yards)	Sign post foundation
1329	Meters (foot)	Steel drive posts, No. 3 posts
1329	Each	Sign, reflectorized, ___ inches x ___ inches including ___-mounted sign attachment

ITEM 1330 - PAVEMENT MARKER BUTTONS

1330.01 Pavement Marker Buttons

1330.02 Method of Measurement

1330.03 Basis of Payment

1330.01 Pavement Marker. The marker shall be a snowplowable type unit constructed of case iron with an acrylic prismatic reflector. The unit shall be implanted in the roadway and secured with an epoxy adhesive.

The marker shall be a Stimsonite Model 96 or 96 LP as specified or an approved equal.

The work of this item shall include pavement cutting using a concrete saw with a multiple blade arrangement to provide a cut to match the contour of the marker housing.

Clean and dry the sawed excavation using a brush or air blast from a compressor air source.

Pour and mix epoxy adhesive in accordance with manufacturer's instructions.

1330.02 Method of Measurement. Pavement marker buttons shall be measured as a complete unit in place, including sawcutting, cleaning and epoxy adhesive.